SD-22

Diminishing Manufacturing Sources and Material Shortages

A Guidebook of Best Practices for Implementing a Robust DMSMS Management Program

DEFENSE STANDARDIZATION PROGRAM OFFICE

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Message from the Director

Diminishing Manufacturing Sources and Material Shortages (DMSMS) problems can be caused by many factors, but they will happen. Robust DMSMS management is crucial. Without it, the readiness of our weapons systems will be degraded, hampering the ability of our warfighters to accomplish their mission and putting their safety at risk. Further, failure to continually address DMSMS issues throughout a system's life cycle can sometimes cost taxpayers millions of dollars.

The B-1 program's DMSMS management team (DMT) overcame obsolescence and supportability issues, resulting in an estimated 10-year cost avoidance of $316 million. Similarly, the Apache program's DMT avoided more than $200 million in expenditures, and the *Virginia*-class submarine's DMT resolved over 1,090 obsolescence issues and reaped over $124 million of documented cost avoidance since inception.

It is imperative for program managers to adopt and fund a robust DMSMS management strategy and plan, in concert with proactive technology management, early in the life cycle. This is a program's most effective and efficient way to minimize materiel readiness risks due to DMSMS issues, realize future savings during production and sustainment, deliver better buying power, and improve overall life-cycle management. All program managers should task their DMSMS offices to assess the adequacy of their DMSMS management efforts. Deficiencies should be corrected as soon as possible. It's a matter of lives, readiness, mission success, and dollars.

A robust DMSMS management program consists of five interrelated steps: prepare, for example, develop a DMSMS strategy and obtain funding; identify items with immediate or near-term obsolescence issues; assess the items to prioritize those most likely to affect readiness or availability; analyze possible resolutions; and implement the most cost-effective solutions. This guidebook—designed primarily for the DMSMS practitioner, provides best practices for robust DMSMS management. Program managers, engineers, and life-cycle logisticians should find the guidance particularly useful.

The guidebook will be updated periodically. This version of SD-22, *Diminishing Manufacturing Sources and Material Shortages: A Guidebook of Best Practices for Implementing a Robust DMSMS Management Program,* replaces a version published in September 2010. Recommended changes to this document should be addressed to the Defense Standardization Program Office, 8725 John J. Kingman Road, Stop 5100, Fort Belvoir, VA 22060-6220 or email at DSPO@dla.mil.

Gregory E. Saunders
Director, Defense Standardization Program Office

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1. Introduction

1.1. Scope and Objective

A Diminishing Manufacturing Sources and Material Shortages (DMSMS) issue is the loss, or impending loss, of manufacturers or suppliers of items, or raw materials, or software. The Department of Defense (DoD) loses a manufacturer or supplier when that manufacturer or supplier discontinues production of needed components or raw materials, or the supply of raw material is no longer available. This can be caused by many factors—such as low-volume market demand, new or evolving science or technology, detection limits, toxicity values, and regulations related to chemicals and materials—that significantly affect the DoD supply chain and industrial base. This situation may cause shortages that endanger an ongoing production capability and/or the life-cycle support of a weapon system or any training, support, or test equipment already in the field.[1] Ultimately, DMSMS issues affect materiel readiness and operational availability, which, in turn, affect both combat operations and safety.

No system or program is immune from DMSMS issues. They affect short- and long-lived systems; reparables and consumables; space-based, air-based, ground-based, and sea-based equipment (including support and test equipment); and so on. DMSMS issues are not confined to piece parts or devices; obsolescence may occur at the part, module, component, equipment, or system level. DMSMS issues are also not limited to defense-unique items; commercial off-the-shelf (COTS) items represent a significant obsolescence problem, because such items are most susceptible to market forces. Historically, DMSMS management has been most closely associated with electronics. This is no longer the case. DMSMS managers are now equally concerned with materials, non-electronics items, and software.[2]

This standardization document, which replaces the September 2010 version of SD-22, is intended primarily for the DMSMS practitioner community. It is a guidebook of best practices for implementing an effective DMSMS management program throughout the system life cycle. Because DMSMS considerations affect how a system is designed and sustained, program managers (PMs), engineers, and life-cycle logisticians (including supply chain managers, inventory managers, and maintainers) are also affected. Consequently, as beneficiaries of DMSMS management best practices, these communities and their associated policymakers are also part of the intended audience.

The purpose of this document is fivefold:

- Create awareness of the extent and impact of DMSMS issues on DoD systems.
- Define a robust DMSMS management process that a PM can use to build an effective DMSMS management program.
- Define DMSMS support metrics to measure the effectiveness of a robust DMSMS management program.

[1] The word “system,” as used in this document, encompasses weapon systems and training, support, and test equipment.

[2] Software obsolescence will be covered in a future update of this document. Generally, the use of the word “item” in this document is intended to be all-inclusive of parts, assemblies, software applications, and material.

- Promote affordable and efficient program support through rapid and cost-effective DMSMS best practices and resolutions that take into account equipment life cycles, technology changes, and preplanned obsolescence.
- Promote the exercise of DMSMS management best practices throughout the acquisition life cycle.

1.2. DMSMS Policy and Guidance

The *DoD Supply Chain Materiel Management Regulation* establishes DMSMS policy for DoD. Within this regulation, DMSMS policy directs that DoD components do the following:[3]

- "Proactively take timely and effective actions to identify and minimize the DMSMS impact on DoD acquisition and logistics support efforts.
- "Develop a process to resolve problems created by DMSMS and reduce or eliminate any negative impacts.
- "Proactively consider DMSMS through[out] a system's life cycle by anticipating potential DMSMS occurrences and taking appropriate logistics, acquisition, and budgeting steps to prevent DMSMS from adversely affecting readiness or total ownership cost.
- "Aggressively pursue … actions," when an item is identified to have a DMSMS problem, "particularly, when those items threaten to degrade weapon system readiness below established goals.[4]
- "Establish DMSMS programs that shall reduce or eliminate the cost and schedule impacts of all identified DMSMS problems and help ensure that DMSMS problems do not prevent weapon system readiness and performance goals from being met."

Procedures for meeting DMSMS management requirements are also established as follows:[5]

- "Each DoD Component shall designate a focal point to plan and coordinate actions to minimize the impact of DMSMS.

[3] *DoD Supply Chain Materiel Management Regulation*, DoD 4140.1-R, May 2003, p. 75. Terminology and organizational entities used in quoted material have evolved since the last update of DoD 4140.1-R.

[4] According to DoD 4140.1-R (pp. 77–78), mitigating actions include the following: "C3.6.2.4.1. Encourage the existing source to continue production"; "C.3.6.2.4.2. Use the current item specification to find another source"; "C3.6.2.4.3. Convert the existing item specification to a performance-based specification, which provides more flexibility in acquisition approaches and facilitates identifying another source"; "C3.6.2.4.4. Obtain an existing substitute item that will perform fully (in terms of form, fit, and function) in place of the DMSMS item"; "C3.6.2.4.5. Redefine requirements through applicable engineering support activities, and consider buying from a commercial source"; "C3.6.3.4.6. Use current manufacturing processes to produce a substitute item (form/fit/function) for the unobtainable item"; "C3.6.2.4.7. Make a 'bridge buy' of a sufficient number of parts to allow enough time to develop another solution"; "C3.6.2.4.8. Make a life-of-type buy"; "C3.6.2.4.9. If a contractor using Government Furnished Equipment (GFE) stops production, reclaim the GFE and reissue it to a new source to help establish production capabilities"; "C3.6.2.4.10. Reclaim DMSMS parts from marginal or out-of service equipment or, when economical, from equipment that is in a long supply or potential excess position"; "C3.6.2.4.11. Reverse engineer the item to develop an exact replica of the item"; "C3.6.2.4.12. Modify or redesign the end item to drop the part in question or replace it with another"; "C3.6.2.4.13. Replace the system in which the DMSMS item is used"; "C3.6.2.4.14. Require the using contractor, through contractual agreements, to maintain an inventory of DMSMS items for future DoD production demands"; and "C3.6.2.4.15. Obtain a production warranty."

[5] *DoD Supply Chain Materiel Management Regulation*, DoD 4140.1-R, May 2003, pp. 75–79.

- “Commanders of activities with responsibility for design control, acquisition, and management of any centrally managed item used within weapon systems or equipment shall implement the DMSMS program by establishing internal procedures.
- “When an item is identified as [having a] DMSMS [problem], the DoD Components should implement the most cost-effective solution consistent with mission requirements.
- “The DoD Components shall send to the cognizant [integrated materiel manager] (IMM) the information that was originally obtained from industrial sources about an actual or prospective announcement of a manufacturer’s intent to stop production. This information shall allow DMSMS broadcast alerts to be generated, if applicable. The cognizant IMM shall notify the [Government-Industry Data Exchange Program] (GIDEP) to establish a DMSMS case.
- “The DoD Components shall ensure that the [Inventory Control Point] (ICP) maintains post-action surveillance throughout the life of DMSMS items in the logistics system.
- “The DoD Components and Security Assistance customers who use the specific items shall respond to requests for requirements information needed to decide the best course of action for ensuring continued supply of DMSMS items. Timely responses are required to meet contractor-imposed final action deadlines. For DMSMS cases involving multiple parts and multiple users, Integrated Product Teams (IPTs) shall be established to coordinate DoD assessment and response to ensure that adequate logistics support may be maintained for affected weapon systems.”

This standardization document contains DoD-wide DMSMS management guidance. The role of guidance is to amplify policy and help close gaps between policy and practice.

Considering overarching DoD policy and guidance, the DoD components have created their own policies, which can be found in the DMSMS Knowledge Sharing Portal (DKSP), described in Appendix G. The DKSP also shows DoD component guidance documents.

1.3. The Importance of a DMSMS Management Program

Because DMSMS management has a significant effect on many aspects of a program, it is not a standalone function. DMSMS management is inherently linked with reliability, maintainability, supportability, and availability. Within this context, it is important to plan for, minimize, and manage the risks associated with DMSMS issues, due to their detrimental impact on materiel readiness, operational mission capability, safety of personnel, and affordability.

Materiel readiness is an immediate and urgent concern for the warfighter. Missions are affected if equipment cannot be supported; either the equipment is not available for the mission, or it cannot be sustained throughout the mission. DMSMS issues can negatively affect supportability if the parts needed to repair a system are not available or in scarce supply. It is unacceptable for a system to be non-mission capable due to a DMSMS issue. To allow a DMSMS situation to progress to the point of affecting a mission (because parts are not available) is contrary to DoD policy and is an indication of ineffective DMSMS management. In addition, ineffective DMSMS management can cause rapid escalation of the costs for parts.

A robust DMSMS management program is the most effective and efficient way to minimize materiel readiness risks due to DMSMS issues, deliver better buying power, and improve overall life-cycle management. DMSMS resolutions are based on the most cost-effective approach to

managing the problem before operations are affected. Cost avoidance can be substantial, as discussed below:

- The B-1 program office was informed by the original equipment manufacturer (OEM) that a radar system was experiencing obsolescence and the recommended system upgrade needed to resolve the problems would cost $350 million. DMSMS monitoring and surveillance indicated only minimal obsolescence existed, and the analysis team identified readily available alternate component parts to replace the ones identified as obsolete. The bottom line was that obsolescence and supportability issues were easily overcome, allowing adequate cost-effective system support through continued organic depot repair with an estimated 10-year cost avoidance of $316 million.
- The Apache obsolescence working group shares power equally between the government and contractor. Issues and details are discussed and resolved within this small team with an expansion of participation as needed from other functional disciplines. An empowered program office champion drives recommendations to reality. This model has resulted in early discovery and intervention of obsolescence risks in an environment of agreed-to mitigation plans. The benefit has been no part shortages or schedule delays, identification of funding to mitigate obsolescence that does not require “robbing Peter to pay Paul,” and required redesign blended into planned design updates. The success of this model and this program is best represented by the cost avoidance realized by this working group across all configurations and life-cycle phases of this system—over $200 million.
- The *Virginia*-class submarine program integrated DMSMS management into the construction program early in the design/build process. To ensure consistency and repeatability of results, the program office established a technology refresh IPT, formalized a standard operating procedure, developed a memorandum of agreement with the Naval Supply Systems Command for the advanced procurement of spares, and established a budget. As a result, the program has resolved over 1,090 obsolescence issues and reaped more than $124 million of documented cost avoidance since inception.
- A foreign military sales (FMS) DMSMS team was asked to look into an obsolete part (a digital display indicator) needed for critical support equipment used by FMS customers. The OEM was unable to fulfill a request for the support equipment due to the obsolete part and quoted $2.6 million for redesign. The FMS DMSMS team examined an available drawing, identified the vendor part number, researched the supply system, located the original vendor, and was able to obtain 50 of the parts needed (more than the required quantity) for $327,000, resulting in a $2.3 million cost avoidance. The extra parts were transferred to the inventory of another platform using the same equipment.

The examples demonstrate how DMSMS management can result in better value for the taxpayer and the warfighter. However, benefits extend well beyond these examples. The Under Secretary of Defense for Acquisition, Technology, and Logistics signed a memorandum for acquisition professionals that provided specific guidance for improving the way DoD does business. That memorandum identified the following broad initiatives:[6]

- Target affordability and control cost growth.
- Incentivize productivity and innovation in industry.
- Promote real competition.
- Improve tradecraft in services acquisition.
- Reduce nonproductive processes and bureaucracy.

Robust DMSMS risk management is an important contributor to the first four of these initiatives. DMSMS management helps target affordability and control cost growth in several ways. By accounting for DMSMS issues during design (trades), future operating and support (O&S) costs will be reduced. For example, the use of modular open systems, standardized parts, and the latest technologies can reduce the impact of DMSMS issues during sustainment by enhancing the interchangeability, reliability, and availability of parts. Robust DMSMS management may enable programs to control cost by achieving "should cost" estimates.

To incentivize productivity and innovation in industry, robust DMSMS management will cultivate long-term relationships with suppliers. Given such relationships, suppliers should be less likely to discontinue an item, and if they decide to discontinue the item for business reasons, the government is more likely to have advanced warning, placing it in a better position to plan an alternative course of action. This planning could be done in coordination with industry.

Promoting real competition by developing alternate sources of items with DMSMS issues is also a key element of robust DMSMS management. Both open systems architecture and data rights in designs enable competition by providing a framework for decomposing a system into components and obtaining the necessary technical information for them. Open systems architecture is an important DMSMS-related design consideration, because it makes it easier to substitute alternative parts. Robust DMSMS management will secure data rights/bills of materials (BOMs) for items highly likely to face DMSMS issues.

Service contracts are often used for system support. Clauses in these contracts may require a contractor to manage DMSMS issues. Those clauses must have the right incentives for robust DMSMS management, including effective metrics and notification of issues to the government as soon as they are discovered. For example, if the contractor is concerned only with availability, then costs may get out of control. The proper incentives must be in place for the contractor to manage DMSMS issues, considering both industry and government perspectives. This is where the initiative to improve tradecraft in services acquisition comes into play.

[6] Under Secretary of Defense for Acquisition, Technology, and Logistics, Memorandum for Acquisition Professionals, "Better Buying Power Guidance for Obtaining Greater Efficiency and Productivity in Defense Spending," September 14, 2010.

1.4. DMSMS Emphasis Areas

The Systems Engineering Office in the Office of the Secretary of Defense (OSD) has established four goals related to DMSMS management.[7]

- *Ensure that system engineering design trades consider DMSMS concerns.* This has been a neglected area, and a significant effort is required to make this a reality. Emphasis on schedule and performance often leave little room in the design trade space for the consideration of other things. However, as will be discussed in Section 2 of this document, DMSMS considerations are one among many systems engineering (SE) design considerations that should be addressed. Appendix B discusses the contractual elements.
- *Reach out to PMs and senior leaders regarding the importance and benefits of a robust DMSMS management approach.* There are many types of opportunities for outreach activities, such as the annual Standardization and DMSMS Conference, Defense Acquisition University (DAU) courses, the DMSMS Working Group, and the Defense Knowledge Sharing Portal (see Appendix G). This guidebook also serves as outreach in that it documents the value of and best practices for the establishment and operation of a DMSMS management program.
- *Improve the early identification and dissemination of potential DMSMS issues and warnings.* The secret of a successful, robust DMSMS management program is knowledge of impending problems as soon as possible, so actions can be taken early enough to avoid negative repercussions. Once a problem is identified, determining its impact and identifying a solution should be straightforward, given an effective methodological approach. (However, funding for implementing the solution may prove challenging.) Current digital environments greatly enhance DoD’s capability for early identification and also enable sharing of this information across the DoD enterprise.
- *Improve the methodological foundation of the DMSMS management process.* Following the identification of potential DMSMS issues, the remaining steps of DMSMS management processes are to prioritize the parts most at risk, analyze the situation to develop a resolution, and implement the resolution. These steps are easily stated, but they are not always easily accomplished. The DMSMS community should be open to a variety of approaches that are most amenable to the particular situation.

1.5. Overview of the DMSMS Management Process

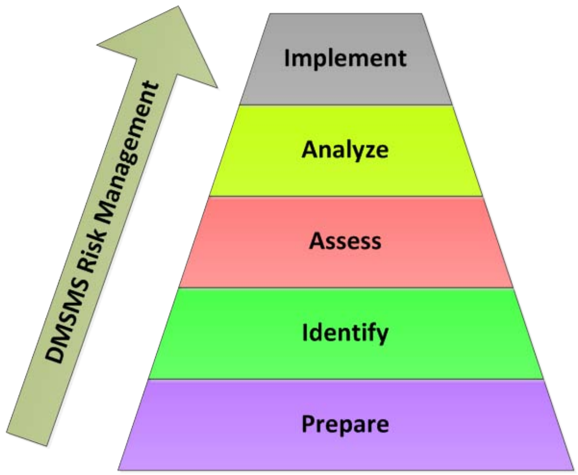
The DMSMS management process is straightforward. As illustrated in Figure 1, it has five steps:

- *Prepare.* Develop a DMSMS strategy and a DMSMS management plan (DMP). Form a DMSMS management team (DMT) representing all stakeholders. Establish, document, and resource DMSMS management processes that the DMT should follow.
- *Identify.* Secure access to logistics, programmatic, and item data and to monitoring and surveillance tools. Identify items with immediate or near-term obsolescence issues.

[7] Chet Bracuto, Alex Melnikow, and Ed Zalinski, “New Synergies between Systems Engineering and DMSMS,” *Defense Standardization Program Journal*, January/March 2010.

- *Assess*. Considering the population of problem items, identify and prioritize the items and assemblies most at risk for current and future readiness or availability impacts.
- *Analyze*. Examine the problem items with near-term readiness or availability impacts first. Develop a set of potential DMSMS resolutions for the items and their higher level assemblies. Determine the most cost-effective resolution.
- *Implement*. Budget, fund, contract or arrange for, schedule, and execute the selected resolutions for the high-priority items.

Figure 1. Steps in the DMSMS Management Process



Each of these steps applies throughout the life cycle, from early technology development through sustainment. Although it is best to begin these activities early in the life cycle, they may be initiated at any point in the process. Ultimately, the DMSMS management process constitutes DMSMS risk management.

1.6. Organization of This Document

The five steps of the DMSMS management process constitute the core organizing principle for this document:

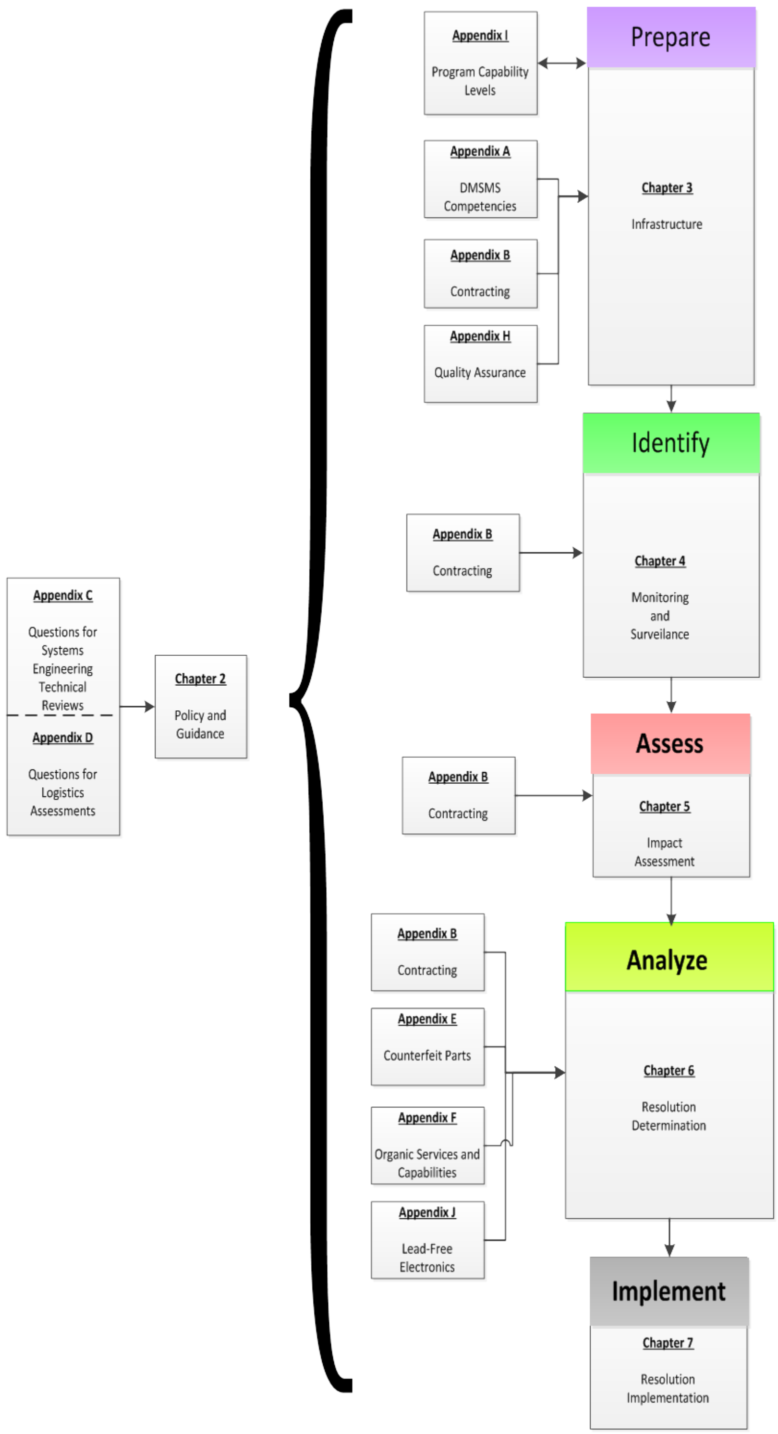
- Section 2 discusses the link between DMSMS management and the defense acquisition system, with particular focus on SE and life-cycle product support. This section provides important input to and context for the rest of the document.
- Section 3 addresses the *prepare* step of DMSMS management. Specifically, it describes best practices for establishing a strong infrastructure—data, people, processes, management reports, and financial resources—for successful DMSMS management.
- Section 4 focuses on the *identify* step, which encompasses DMSMS monitoring and surveillance throughout the life cycle and includes best practices for determining where to focus DMSMS management efforts.
- Section 5 discusses the *assess* step of DMSMS management. It begins with a discussion of the monitoring and surveillance data collected; it also describes how to measure the operational impacts of the risks and how to prioritize them.

- Section 6 focuses on the *analyze* step, which deals with analyzing alternative approaches for resolving DMSMS issues and identifying the preferred alternative. This section lists DMSMS resolution options and provides a basis for estimating their cost. It also identifies risk factors associated with these options.
- Section 7 addresses the *implement* step, which covers the implementation of the preferred resolution option. It discusses potential sources of implementation funding, the roles of the DMT during implementation, and some considerations associated with common implementation issues.

Appendixes A through J contain supporting detail about DMSMS activities, such as questions that need to be addressed for SE technical reviews and logistics assessments (LAs), examples of contract language related to DMSMS management, DMSMS workforce competencies and the capabilities of a robust DMSMS management program, DMSMS implications of counterfeit parts and lead-free electronics, best practices for the quality assurance of DMSMS processes, and ways to access additional DMSMS knowledge and organic services and capabilities. Appendix K defines abbreviations used throughout this document.

Figure 2 shows the high-level interrelationships of the five DMSMS steps, the corresponding sections of this document, and the supporting appendixes. The figure does not show Appendix G, which contains reference information about all DMSMS activities.

Figure 2. Interrelationships among the DMSMS Processes and the Document's Components



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2. DMSMS Management Links to Affordability and Defense Acquisition System Policy and Guidance

This section addresses materiel readiness and systems engineering guidance and their relationship to DMSMS management. Program and DMT leaders are the primary target audience. More specific information for DMSMS practitioners begins with Section 3.

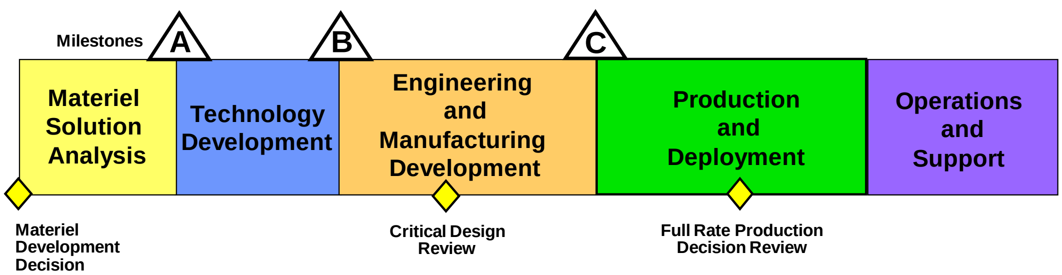
2.1. Overview

Department of Defense Directive (DoDD) 5000.01, "The Defense Acquisition System," contains principles, policies, and procedures for managing all acquisition programs. One such policy establishes the importance of cost and affordability over the life cycle of a DoD system:

> All participants in the acquisition system shall recognize the reality of fiscal constraints. They shall view cost as an independent variable, and the DoD Components shall plan programs based on realistic projections of the dollars and manpower likely to be available in future years. To the greatest extent possible, the MDAs [Milestone Decision Authorities] shall identify the total costs of ownership, and at a minimum, the major drivers of total ownership costs. The user shall address affordability in establishing capability needs.[8]

Figure 3 depicts the acquisition life cycle.

Figure 3. Acquisition Life Cycle



Systems engineering is the technical management approach used to ensure consideration of affordability. According to DoDD 5000.01,

> acquisition programs shall be managed through the application of a systems engineering approach that optimizes total system performance and minimizes total ownership costs. A modular, open-systems approach shall be employed, where feasible.[9]

[8] "The Defense Acquisition System," DoDD 5000.01, May 2003 (certified current as of November 2007, p. 5.

[9] "The Defense Acquisition System," DoDD 5000.01, May 2003 (certified current as of November 2007, p. 9.

DoDD 5000.01 also provides the PM with the responsibility and authority to ensure that cost and affordability are considered throughout the life cycle. This is termed total life-cycle systems management:

> The PM shall be the single point of accountability for accomplishing program objectives for total life-cycle systems management, including sustainment. The PM shall apply human systems integration to optimize total system performance (hardware, software, and human), operational effectiveness, and suitability, survivability, safety, and affordability. PMs shall consider supportability, life cycle costs, performance, and schedule comparable in making program decisions. Planning for Operation and Support and the estimation of total ownership costs shall begin as early as possible. Supportability, a key component of performance, shall be considered throughout the system life cycle.[10]

The role of the PM changes over the life cycle of a system. Before the establishment of Initial Operational Capability (IOC), the PM is responsible for the design, development, and production of the system with two primary goals: meet performance requirements and minimize life-cycle costs. Once the system is fielded, the PM is responsible for affordably supporting the system as it is used for both training and operations.

Robust DMSMS management is important to the PM, because it accomplishes the following:

- Establishes criteria for evaluating design alternatives from a DMSMS management perspective
- Ensures that all parts and material to design, produce, or repair the system or equipment are available
- Reduces, or controls, total ownership cost
- Provides for risk mitigation as it applies to DMSMS issues
- Identifies potential DMSMS issues early enough to allow a variety of solution approaches
- Evaluates more than one approach to resolve DMSMS issues
- Collects metrics to monitor program effectiveness.

The importance of DMSMS management to the PM for ensuring cost and affordability throughout the system life cycle has also been highlighted: "Obsolescence and DMSMS will eat your lunch (along with breakfast and dinner if you're not careful.)"[11] The PM should adopt an aggressive DMSMS management strategy and plan. This will help ensure that modifications and service life extensions will be effective from a supportability perspective. Continuous modernization and technology insertion/refreshment are important enablers.

Directive Type Memorandum (DTM) 10-015, "Requirements for Life Cycle Management and Product Support," states that a "Product Support Manager (PSM) position shall be established and assigned for each Acquisition Category (ACAT) I and ACAT II system and filled by a properly qualified Military Service member or full-time employee of the Department of Defense."[12] One of the PSM's primary duties is to "provide weapon systems product support sub-

[10] "The Defense Acquisition System," DoDD 5000.01, May 2003 (certified current as of November 2007, p. 10.

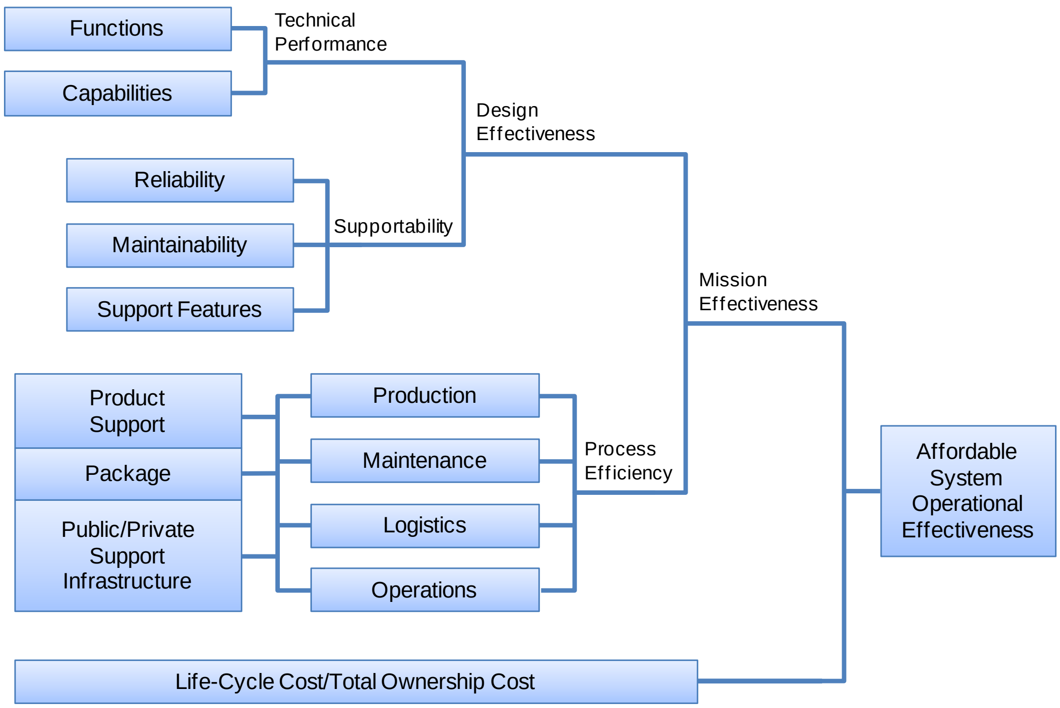
[11] Bill Kobren, "10 Things Great Program Managers Know about Product Support," *Defense AT&L*, November–December 2011.

[12] *Requirements for Life Cycle Management and Product Support*, DTM 10-015, October 2010 (incorporating Change 2, December 2011), p. 2.

ject matter expertise to the PM for the execution of the PM's duties as the Total Life Cycle Systems Manager."[13] To accomplish this, the PSM advises the PM about design tradeoffs that enhance supportability and develops and implements a performance-oriented product support strategy. A product support plan is generated from the strategy and its corresponding product support package to achieve desired materiel availability results.

The *Defense Acquisition Guidebook* (DAG) establishes a framework for the PSM to carry out these functions, as shown in Figure 4.[14]

Figure 4. Framework for Ensuring Affordable System Operational Effectiveness



Source: *Defense Acquisition Guidebook*, January 2012.

According to the DAG, affordable system operational effectiveness is achieved by designing for the optimal balance between performance (design effectiveness), total ownership cost, and process efficiency that enables the delivery and sustainment of performance. The concept of affordable system operational effectiveness is important, because it is what the warfighter sees in terms of how well the system performs its missions over a sustained period, as well as how well it supports a surge, given the operating budget. In this concept, the emphasis is not only on the system's ability to execute its mission or its reliability and maintainability, but also on the cost-effective responsiveness of the supply chain.

The framework should not be viewed as static. Initially, the design is a driver of the product support strategy. However, one of the tenets of evolutionary acquisition is incremental block development. Future increments of design are influenced by new technical performance requirements, the current degree of supportability, the current product support concept, and affordability. Con-

[13] *Requirements for Life Cycle Management and Product Support*, DTM 10-015, October 2010 (incorporating Change 2, December 2011), p. 5.

[14] See https://dag.dau.mil/Pages/Default.aspx.

sequently, life-cycle cost and process efficiency affect supportability in future increments of the system.

The following two subsections expand upon the framework's two major elements: design effectiveness and process efficiency.

2.2. Design Effectiveness and DMSMS

The DAG describes how design effectiveness reflects the key design features of technical performance and supportability.[15] These characteristics should be designed into the system synergistically and with full knowledge of the expected system missions within the context of the proposed system operational, maintenance, and support concepts. To be effective, technical performance and supportability objectives should be defined in explicit, quantitative, and testable terms. This is important to facilitate tradeoffs, as well as to support the selection and assessment of the product and process technologies.

2.2.1. Technology and Supply Chain Management

The design process translates functional architectures into physical architectures with technical specifications, ranging from higher level assemblies down to component parts and software elements. The process may be applied during the design of a new system or the redesign of an existing system; thus, it applies throughout the life cycle.

A strategic understanding of the supplier base improves design effectiveness. Such an understanding provides a picture of the health of the industrial base and its ability to develop, produce, maintain, and support the system and, thereby, may serve as an early warning to designers of potential DMSMS issues.

DoD guidance recognizes the utility of these early warnings to acquisition in general. Every program should assess industrial capabilities during the Technology Development phase.[16] This assessment addresses the implications of planned technology development on competitiveness and the viability of essential industrial and technological capabilities.

From a DMSMS perspective, technology management is one of the most important aspects of supply chain management throughout the life cycle. Beyond the Technology Development phase, this approach is also referred to as modernization through spares, continuous modernization, or technology insertion/refreshment. Effective technology management enables a design acquisition strategy and life-cycle sustainment strategy that minimizes the cost of resolving future obsolescence issues, while incorporating state-of-the-art technologies to increase reliability, lower sustainment requirement costs, and increase warfighting capability to meet evolving requirements throughout an indefinite service life. Robust DMSMS management by itself will, of course, lower the costs associated with obsolescence issues. However, even in the best of programs, DMSMS resolutions are often suboptimal. Life-of-need procurements are problematic because of limited contractual horizons and uncertainties in estimating the total requirement over the remainder of the life cycle. Finding or qualifying alternative items may work for a time, but such approaches rarely take advantage of new technologies and capabilities. Unplanned rede-

[15] Supportability encompasses the extent to which design characteristics and logistics resources enable attainment of availability goals.

[16] *Defense Acquisition Guidebook*, January 2012, Section 2.2.9.

signs are costly. Therefore, incorporating a technology management strategy into design, acquisition, and sustainment activities is a best practice to further reduce DMSMS cost and readiness impacts throughout the life cycle. Designers should consider potential seamless upgrade paths for technologies and components and should provide a timetable for replacing items even if they are not obsolete.

Effective technology management begins with a strategic understanding of the market and its trends. Market research entails collecting information about existing and emerging technologies, products, manufacturers, and suppliers. It has two components:

- Market surveillance—a continuous canvassing of the commercial market to identify existing and future technologies, vendors' products, and market trends that can potentially meet existing and emergent requirements from a strategic perspective. Market surveillance methods include searching the Internet, attending trade shows, reading technology publications, hiring consultants, issuing requests for information from prospective manufacturers/suppliers, visiting manufacturer/supplier facilities, and viewing product demonstrations.
- Market investigation—a focused process of identifying and determining if specific technology products can meet particular functional requirements. Market investigation also includes system obsolescence profiling to proactively plan for the continued support or replacement of soon-to-be obsolete products. This product-level information and the associated budget requirements form the basis for sustaining the operation or functionality of a system. Market investigation methods can include beta testing; prototyping; testing for compliance, conformance, and compatibility; and querying manufacturers/suppliers about product obsolescence status.

Market research occurs in all of a system's life-cycle phases, allowing the acquiring activity to do the following:

- Anticipate obsolescence situations due to rapid and asynchronous product changes.
- Plan and budget using a broader range of product obsolescence management options.
- Maintain insight into technology trends, as well as internal product changes by the manufacturer, and to test the effects of those changes on the system.
- Assess the quality of a manufacturer and the impact on a system of a product's change, including its suitability for the user, information security characteristics, and supportability.
- Determine the manufacturer's support period and inventories for a particular product.

Ignoring market research increases the likelihood of poor product and technology selections, as well as an inability to effectively predict and mitigate obsolescence impacts. This can negatively impact program performance, schedule, and cost.

The result of this effort will be a technology road map that identifies alternative technology paths for meeting performance targets.[17] The technology road map provides a basis for technology management encompassing technology updates to obtain the latest generation of components and software applications, technology insertion to increase capabilities, and technology refresh to avoid obsolescence issues. The example in Section 1 of the *Virginia*-class submarine with 1,090

[17] Marie L. Garcia and Olin H. Bry, *Fundamentals of Technology Roadmapping*, SAND97-0665 (Albuquerque, NM: Sandia National Laboratories, April 1997).

resolved technology refresh issues is a case in point. Effective technology management implies that resolutions are planned before effects occur. The next subsection discusses some design considerations that can enhance the likelihood of achieving that result.

2.2.2. DMSMS As a Consideration in Design

Design effectiveness is an overarching outcome of systems engineering. This is where the PSM provides advice about design tradeoffs. Section 4.4 of the DAG, "Systems Engineering Design Considerations," discusses how design is a complex task that must balance a large number of performance, support, safety, environmental, security, regulatory, and other requirements and constraints. Because a feasible solution can rarely satisfy all of these things in a cost-effective way, the SE process guides design tradeoffs to develop a balanced solution for all stakeholders.

In his keynote address at the 2010 DMSMS and Standardization Conference, Mr. Stephen Welby, the Deputy Assistant Secretary of Defense for Systems Engineering, emphasized the importance of DMSMS considerations in design.[18] He posed the following questions:

- Are we appropriately trading DMSMS concerns with other design considerations?
- Are DMSMS management activities during O&S adequately considered in upfront design activities?
- Are DMSMS considerations adequately covered in technical reviews and engineering plans?[19]

DMSMS is one among many product support design considerations.[20] The DAG points out that DMSMS issues may endanger the life-cycle support and capability of a system and that a robust approach is needed to resolve problems before they cause a negative impact on system readiness or cost.

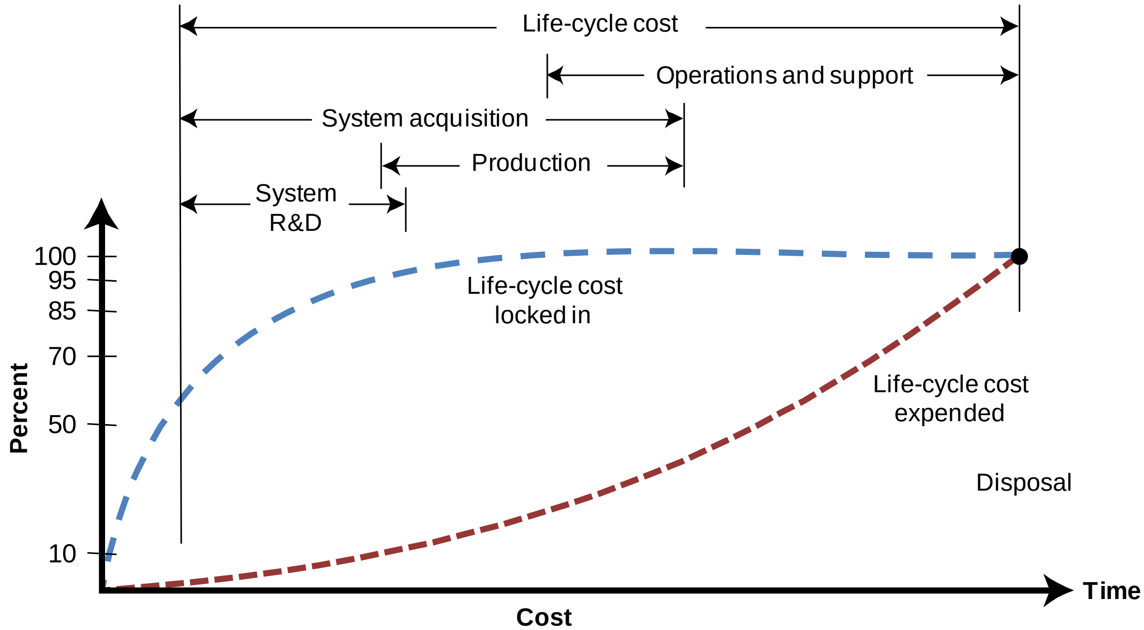
Design decisions made early in a program—for example, during the Materiel Solution Analysis, Technology Development, and Engineering and Manufacturing Development phases—have a substantial impact on operations and support costs later in the program. As shown in Figure 5, a high percentage of the life-cycle costs of a program are locked in based on early design.

[18] Stephen Welby, Deputy Assistant Secretary of Defense for Systems Engineering, "Bridging Acquisition and Logistics" (presentation, 2010 DMSMS and Standardization Conference, Las Vegas, NV, October 25–28, 2010).

[19] Systems engineering technical reviews are an important oversight tool that the program manager can use to review and evaluate the state of the system and the program, redirecting activity if necessary. See *Defense Acquisition Guidebook*, January 2012, Section 4.5.9.

[20] The design considerations are accessibility; COTS; corrosion prevention and control; critical safety items; disposal and demilitarization; DMSMS; environment, safety, and occupational health; human systems integration; insensitive munitions; interoperability; open systems design; parts management; program protection and system assurance; quality and producibility; reliability, availability, and maintainability; software; spectrum management; standardization; supportability; survivability and susceptibility; and unique identification of items. See *Defense Acquisition Guidebook*, January 2012, Section 4.4.

Figure 5. Relationship between a Program's Expended Life-Cycle Cost and Locked-in Cost



Source: W.J. Larson and L.K. Pranke, *Human Spaceflight: Mission Analysis and Design* (McGraw-Hill, 1999).

While undergoing the design process, "the program manager faces a myriad of considerations and management tools to translate the user's desired capabilities (regardless of phase in the acquisition cycle) into a structured system of interrelated design specifications."[21] Performance, supportability, logistics, cost, and other considerations all have to be balanced and trades made to produce the optimal design. For a redesign effort, specifications already exist, which may constrain the ability to determine an optimal design. DMSMS is one of the many considerations informing design decisions. If unique, highly specialized parts are used to meet performance requirements, DMSMS issues during the O&S phase will be more prevalent.

This subsection discusses DMSMS design considerations that have a greater potential to affect the life expectancy of a system or its components and the DMSMS risk posed. Below are several design concepts that a designer/systems engineer should consider to minimize DMSMS risk throughout the life cycle of the system being designed:

- *Technology and component selection.* New technologies do not capture 100 percent of the market all at once; there is a period of time when both the new technology and the one it replaces are in use. The design should not include anything that is near the end of its functional life. A technology road map is useful when designing systems, especially electronics systems.
- *Parts management.* Parts management is the practice of considering the application, standardization, technology, reliability, maintainability, supportability, and cost when selecting parts to address availability, logistics support, DMSMS, counterfeit, and legacy issues

[21] *Defense Acquisition Guidebook*, January 2012, p. 272.

throughout the life cycle.[22] An up-front assessment of the risk of obsolescence should influence parts selection during the design process. Parts selection encompasses both the selection of new parts and the reuse of parts from previous designs. This assessment should consider material selections, economic and regulatory trends, unique manufacturing processes, packaging schemes, and so on. Before including a part on a preferred parts list, the identified risks should be assessed and managed in order to make the BOM stable and sustainable.[23] As the design stabilizes, it should minimize the number of OEM or original component manufacturer (OCM) parts necessary for production. When nonpreferred parts are used, their designs should be captured in the proper transportable computer-aided design models.[24]

- *Open systems design—hardware.* Open systems design employs technology-independent modular design tenets, uses widely supported and consensus-based standards for its key interfaces, and is subject to validation and verification, including test and evaluation, to ensure the openness of its key interfaces. An open systems design thereby takes equipment road maps and technology insertion plans into account. Also, compared with design-specific approaches, it enables readily available alternative parts to be used in place of obsolete parts more easily, as long as the substitutes have the same form/fit/function (F3) and interface as the ones they replace and the test interfaces have also been considered. An open systems design reduces DMSMS costs, because it avoids expensive redesign by facilitating the insertion of advanced technologies.[25]
- *Open systems design—software.* To minimize DMSMS impacts, software architecture should be designed to take growth into consideration.[26] This provides for change, while minimizing impact to existing system functions. In addition, the design should allow for partitioning the software into appropriate units that can be tested in isolation and should avoid making software dependent on the hardware. Finally, transportability of models that capture critical elements of the design is a consideration. Significant complexities may be associated with using open system principles for a new software design being incorporated into an existing asynchronous system.
- *Use of COTS assemblies.* COTS assemblies offer opportunities for reduced development time, faster insertion of new technology, lower procurement costs, and potentially, lower life-cycle costs, due to a more robust industrial base. Consequently, DoD systems increasingly comprise COTS assemblies and software. Unfortunately, the use of COTS assemblies also has some challenges. The DoD community has little influence over the far shorter commercial product life cycle. Consequently, information on future availability is hard to obtain. Further, changes during the system life cycle may not be documented, increasing the likelihood

[22] For more information on parts management, see *SD 19, Parts Management,* Defense Standardization Program Office, September 2009, and "Department of Defense Standard Practice: Parts Management, October 27, 2011.

[23] A BOM is a list of the OEM-assigned part numbers.

[24] The most useful method of describing many aspects of a design is through a Hardware Description Language (HDL). An HDL (assuming a satisfactory level of specificity) is easily ported from one generation to the next generation of technology. Life-cycle costs may be reduced significantly through the proper utilization of HDLs. When dealing with microcircuits, the most common HDL is VHDL, or VHSIC Hardware Description Language. VHSIC stands for Very High Speed Integrated Circuit, an earlier multiphase DoD program whose goals included advancement of semiconductor (microcircuit) technology.

[25] The ability to use open systems design for a legacy system is limited.

[26] Software is the primary focus of integration for the development of open, scalable, and adaptable systems.

of configuration management and DMSMS issues. In addition, depending upon the system and program management practices, requalification costs associated with replacing COTS assemblies may be significant. For that reason, the initial cost savings from the use of COTS assemblies may be offset by increased costs later in the life cycle when those assemblies have become obsolete. In short, it may or may not be appropriate to include COTS assemblies in critical paths or functions. Consequently, before including a COTS assembly in a design, the designer or PM should assess the risk and suitability (which should include developing a technology road map and refresh strategy).[27]

Often, it may prove difficult for DMSMS advocates to influence design, because the PM is dealing with numerous competing communities and priorities. Part of the DMSMS community's role is to educate PMs on the importance of identifying and addressing obsolescence issues as early in a program as possible.

The DMSMS community should not be thought of as a single-issue community on its own. Instead, DMSMS should be approached as an integral part of reliability, maintainability, availability, and supportability. Indeed, the DMSMS community might be able to build momentum and weight behind its recommendations by leveraging the interaction that other communities have with the PMs and chief engineers.

The establishment and conduct of a DMT can serve as another point of leverage for the ongoing identification and mitigation of DMSMS issues throughout a program. Such a team would include relevant stakeholders, representing both government and contractors, and ensure regular, scheduled communication to discuss and resolve obsolescence as it pertains to the design of the system for the program in question.

2.2.3. Consideration of DMSMS in Systems Engineering Technical Reviews

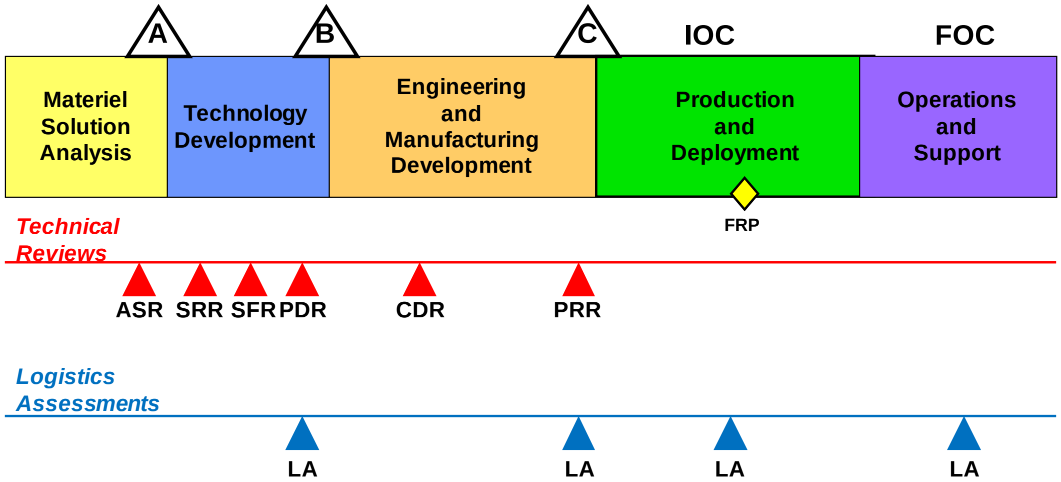
SE technical reviews are used throughout the life cycle as a means for the program office to "confirm major technical efforts within the acquisition phases, affirm outputs of the acquisition phases, and progress toward the next acquisition phase."[28] Technical reviews are "conducted between the program management office and contractor personnel to assist the PM and contractor in assessing technical progress of the program."[29] Figure 6, adapted from the DAG, illustrates how some of the technical reviews relate to the life cycle.

[27] "Standard for Preparing a COTS Assembly Management Plan," EIA-933.

[28] *Defense Acquisition Guidebook*, January 2012, p. 211.

[29] *Defense Acquisition Guidebook*, January 2012, p. 331.

Figure 6. Timing of Systems Engineering Technical Reviews and Logistics Assessments



Note: Adapted from the *Defense Acquisition Guidebook*.

Notes: ASR = Alternative Systems Review, CDR = Critical Design Review, FOC = Full Operational Capability, IOC = Initial Operational Capability, LA = logistics assessment, PDR = Preliminary Design Review, PRR = Production Readiness Review, SFR = System Functional Review, and SRR = Systems Requirements Review.

Table 1 summarizes the purpose of the principal SE technical reviews for DMSMS management, as well as specific issues that may be of interest from a DMSMS management perspective at the time of each technical review.

Table 1. Summary of Principal Systems Engineering Technical Reviews

Phase	Review type	Purpose of technical review	Specific issues of interest from DMSMS perspective
Materiel Solution Analysis	ASR	"Ensure the resulting set of requirements agrees with the customer's needs and expectations and the system under review can proceed into the Technology Development phase." [a]	DMSMS management planning has been initiated and is focused on the most likely preferred systems concepts. DMSMS impacts may be a consideration when performing an AoA to ensure that the preferred system is cost effective, affordable, operationally effective, and suitable and can be developed to provide a timely solution to a need at an acceptable level of risk.
Technology Development	SRR	"Ensure that the system under review can proceed into initial system development, and that all system requirements and performance requirements derived from the Initial Capabilities Document or draft Capability Development Document are defined and testable, and are consistent with cost, schedule, risk, technology readiness, and other system constraints." [b]	The program has begun to develop its DMSMS management strategy and plan, which begins to identify the roles and responsibilities of the government, prime/subcontractor, and third-party vendors. Some members of the DMT and contracting strategies have been identified. Technology development contracts require delivery of data necessary for DMSMS management and define the contractor roles and responsibilities.

Table 1. Summary of Principal Systems Engineering Technical Reviews

Phase	Review type	Purpose of technical review	Specific issues of interest from DMSMS perspective
Technology Development (cont'd)	SFR	"Ensure that the system's functional baseline is established and has a reasonable expectation of satisfying the requirements of the Initial Capabilities Document or draft Capabilities Development Document within the currently allocated budget and schedule." [c]	The DMSMS management plan has been developed and a partial DMT has been formed. The development of DMSMS processes and metrics are underway.
	PDR	"Establish…the physically allocated baseline to ensure that the system under review has a reasonable expectation of being judged operationally effective and suitable." [d]	The DMSMS management plan, including the documentation of all operational processes, has been formally approved by program leadership. Monitoring and surveillance for DMSMS issues, using predictive tools and market surveys, are being conducted for notional or preliminary parts list/BOM. Impact assessment (using estimated reliability data), resolution determination, and resolution implementation have begun. Technology road maps and refresh strategies are being factored into DMSMS management processes.
Engineering and Manufacturing Development	CDR	"Establish…the initial product baseline to ensure that the system under review has a reasonable expectation of satisfying the requirements of the Capability Development Document within the currently allocated budget and schedule." [e]	Monitoring and surveillance for DMSMS issues, using predictive tools and market surveys, are being conducted for the build baseline/final design, indentured BOM. Impact assessment (using estimated reliability data), resolution determination, and resolution implementation are taking place. Technology road maps and refresh strategies are being factored into DMSMS processes. Case management and the capture of metrics are taking place. Engineering and manufacturing development contracts require delivery of data necessary for DMSMS management and define the contractor roles and responsibilities.

Table 1. Summary of Principal Systems Engineering Technical Reviews

Phase	Review type	Purpose of technical review	Specific issues of interest from DMSMS perspective
Engineering and Manufacturing Development (cont'd)	PRR	"Determine if the design is ready for production and if the prime contractor and major subcontractors have accomplished adequate production planning without incurring unacceptable risks that will breach thresholds of schedule, performance, cost, or other established criteria." [f]	Monitoring and surveillance for DMSMS issues, using predictive tools and market surveys, are being conducted. Impact assessment (using estimated reliability data), resolution determination, and resolution implementation are taking place. Technology road maps and refresh strategies are being factored into DMSMS processes. Case management and the capture of metrics are taking place.

[a] *Defense Acquisition Guidebook*, January 2012, p. 220.

[b] *Defense Acquisition Guidebook*, January 2012, p. 233.

[c] *Defense Acquisition Guidebook*, January 2012, p. 235.

[d] *Defense Acquisition Guidebook*, January 2012, p. 237.

[e] *Defense Acquisition Guidebook*, January 2012, p. 251.

[f] *Defense Acquisition Guidebook*, January 2012, p. 257.

The SE community has developed a checklist for each of the technical reviews. "These checklists are designed as a technical review preparation tool, and should be used as the primary guide for the risk assessment during the review. The checklist itself can be both an input to, and an output of, the review."[30] DMSMS management-related issues also are suitable issues to be considered during all technical reviews.

Appendix C identifies a number of specific DMSMS management-related questions for use in support of technical reviews. The DMSMS management-related questions offered in that appendix have been designed for use by the DMSMS community to inform DMSMS-related discussions before the technical reviews and to highlight DMSMS issues to be addressed during the reviews. DMSMS management-related questions are already incorporated into the SE checklists for technical reviews; however, an effort has been made to expand upon these systematically for DMSMS practitioners.

2.3. Process Efficiency and DMSMS

The DAG defines process efficiency as an indicator of how well the system can be produced, operated, serviced (including fueling), and maintained. It also indicates the degree to which the logistics processes (including the supply chain), infrastructure, and footprint have been balanced to provide an agile, deployable, and operationally effective system. Achieving process efficiency requires early and continuing emphasis on the various logistics support processes, along with other design considerations. An emphasis on process efficiency is important, because processes present opportunities for improving operational effectiveness—via Lean Six Sigma, supply chain optimization, and other continuous process improvement techniques—even after the design-in window has passed. Optimization and continuous process improvement techniques can be applied through, for example, supply chain management, resource demand forecasting, training,

[30] *Defense Acquisition Guidebook*, January 2012, p. 330.

maintenance procedures, calibration procedures, packaging, handling, and transportation and warehousing processes.

The product support package and some of its key functions, as derived from the product support strategy, contribute to process efficiency. The product support package is formulated to provide supportability during the O&S phase of the acquisition life cycle. These are key areas for the PSM to contribute to supportability.

2.3.1. Acquisition Strategy

The Technology Development phase of acquisition is focused on reducing technology risk associated with the set of technologies to be integrated into a full system. Activities in this phase are guided by a Technology Development Strategy (TDS). The TDS is a precursor to the Acquisition Strategy (AS) in that it provides overall cost, schedule, and performance goals for the program. At program initiation, the AS replaces the TDS.

According to the DAG,

> The Acquisition Strategy is a comprehensive, integrated plan that identifies the acquisition approach, and describes the business, technical, and support strategies that management will follow to manage program risks and meet program objectives. The Acquisition Strategy should define the relationship between the acquisition phases and work efforts, and key program events such as decision points, reviews, contract awards, test activities, production lot/delivery quantities, and operational deployment objectives.[31]

The DAG goes on to say that the AS "guides program execution across the entire program life cycle, focusing primarily on the upcoming phase. The strategy evolves over the phases and should continuously reflect the current status and desired end point of the phase and the overall program."[32] Consequently, the combination of the TDS and the AS is the overarching program management plan. DMSMS management concepts are included in these documents in the section dealing with industrial capability and manufacturing readiness. The DMSMS management discussion should address technology obsolescence, replacement of limited-life items, and regeneration options for unique manufacturing processes.[33]

2.3.2. Product Support Strategy

The product support strategy translates warfighter requirements into performance outcomes. It is defined and implemented through a 12-step process, which must be updated regularly throughout the life cycle. Three of these steps, highlighted with expanded explanations in the following list, have been linked with DMSMS management:[34]

- *Integrate warfighter requirements and support.*
- *Form the product support management IPT.*
- *Baseline the system.* This step includes collecting data needed to assess and analyze support decisions. Technology refreshment is an important contributor to the design for support, and

[31] *Defense Acquisition Guidebook*, January 2012, Section 2.3.

[32] *Defense Acquisition Guidebook*, January 2012, Section 2.3.

[33] Sample TDS and Acquisition Strategy outlines are in "Document Streamlining – Program Strategies and Systems Engineering Plan" (April 2011 memorandum from the Principal Deputy Under Secretary of Defense).

[34] *Product Support Manager Guidebook*, 2011.

DMSMS management is recognized as one of several drivers of technology refreshment. The product support strategy itself affects the implementation of DMSMS management both within the program office and with contractors.

- *Identify/refine performance outcomes.*
- *Conduct a business case analysis (BCA).* This step involves using a structured method to identify and compare alternative product support solutions. Obsolescence management is part of the BCA scope. A DoD guidebook recommends the use of DMSMS analytical tools.[35]
- *Analyze the product support value.* This step consists of assessing the results of the BCA to identify the optimal best value product support solution. DMSMS management should be considered as part of best value analysis to optimize life-cycle cost.
- *Determine support methods.*
- *Designate product support integrators.*
- *Identify product support providers.*
- *Identify/refine financial enablers.*
- *Establish/refine product support agreements.*
- *Implement and assess.*

2.3.3. Integrated Product Support Elements

The Life-Cycle Sustainment Plan (LCSP) provides for the execution of the product support package.[36] DMSMS management is identified as a regulatory/statutory requirement that influences sustainment and therefore must be addressed in the LCSP, which identifies a DMP as a key sustainment planning document.

LCSP product support functions are derived primarily from the last five product support strategy steps listed above. Twelve integrated product support elements embody the tasks associated with the product support functions. The 12 elements, listed below, include 6 that are linked with DMSMS management (highlighted with expanded descriptions in the list):[37]

- *Product support management.* This element deals with planning and managing cost and performance across the product support value chain. The product support strategy is not static. It evolves as the system ages, in part because DMSMS issues affect the PSM's ability to provide support, including the cost of that support. Therefore, the product support strategy needs to be reassessed periodically. The changes resulting from this reassessment are reflected in changes to the post-production support plan and the resources required for plan execution.
- *Design interface.* This element deals with participation in the SE process to ensure the design facilitates supportability. DMSMS issues, technology refreshment, and modifications and upgrades are called out as long-term considerations affecting design. DMSMS management presents an important opportunity to influence design.

[35] *Product Support Business Case Analysis Guidebook*, 2011.

[36] See Life-Cycle Sustainment Plan Sample Outline, Version 1.0, August 10, 2010, as promulgated by Principal Deputy Under Secretary of Defense, Memorandum, "Document Streamlining – Life-Cycle Sustainment Plan (LCSP)," September 2011.

[37] *Integrated Product Support Element Guidebook*, 2011, and *Product Support Manager Guidebook*, 2011.

- *Sustaining engineering.* This element deals with the continued operation and maintenance of a system with managed risk. It recognizes that DMSMS problems are a root cause of in-service problems and that modernization should anticipate DMSMS issues. Cautions are raised with the use of COTS assemblies and the risk of underestimating the number of or potential for DMSMS problems. The guidance also links to DMSMS management-related reference material, including this document.
- *Supply support.* This element deals with the identification, planning for, resourcing, and implementation of all management actions to acquire repair parts, spares, and all classes of supply to ensure equipment is ready when needed. Over time, any product support strategy based on the production supply chain will need to shift to a sustainment supply chain. Furthermore, sustainment supply chains will have to be adjusted if DMSMS concerns exist.
- *Maintenance planning and management.*
- *Packaging, handling, storage, and transportation.*
- *Technical data.* This element deals with the identification, planning, resourcing, and implementation of management actions to develop and acquire information to operate and maintain the system. The guidance for this element recognizes that because of DMSMS management and other concerns, the government may need detailed technical data for remanufacturing, reprocurement, or sustaining engineering. The requirement for such technical data should be established during the Technology Development phase of acquisition. There is also a data item description for DMSMS source data. Ultimately, any technical data requirement should be clearly expressed in the appropriate contracts as early as possible and flowed down the supply chain.
- *Support equipment.* This element deals with the identification, planning, resourcing, and implementation of management actions to acquire and support the equipment required to sustain the operation and maintenance of the system. DMSMS management is identified as a consideration in the sustainment of support equipment.
- *Training and training support.*
- *Manpower and personnel.*
- *Facilities and infrastructure.*
- *Computer resources.*

2.3.4. Consideration of DMSMS in Logistics Assessments

The implementation of independent LAs during weapon system development, production, and post-IOC acquisition phases was recommended by the DoD Weapons Systems Acquisition Reform Product Support Assessment to improve the effectiveness of product support.[38] An LA is an analysis of a program's supportability planning, which serves as

> an effective and valid assessment of the program office's product support strategy, as well as an assessment of how this strategy leads to successfully operating a system at an affordable cost…. Conducting the LA early in the program phase where the design can be

[38] *Logistics Assessment Guidebook*, July 2011, p. 2.

> influenced, and reassessing the planning at each milestone and periodically thereafter as the design matures, is critical to fielding a sustainable system.[39]

The LA assesses the product support strategy and how that strategy leads to successfully and affordably operating a system. Because DMSMS issues have a bearing on the sustainment of a system, DMSMS should be considered within LAs. Table 2 summarizes the focus of both pre- and post-IOC LAs.

Table 2. Summary of Logistics Assessments

Assessment type	Focus of assessment	Specific issues of interest from DMSMS perspective
Pre-IOC (at Milestone B, Milestone C, and prior to full-rate production decision)	"Provide senior leadership with the LA results and certification." [a] "Serve to support that particular milestone decision at hand." [b]	Monitoring and surveillance for DMSMS issues, using predictive tools and market surveys, are being conducted to identify immediate and near-term obsolescence issues associated with the system BOM. Impact assessment, resolution determination, and resolution implementation are taking place. Technology road maps and refresh strategies are being factored into DMSMS processes. Case management and the capture of metrics are taking place.
Post-IOC (at least every 5 years)	"Conducted to assess if the Program Manager delivered to the user a system that is supportable per the planned requirements, was executed to the program planning documentation, is within the estimated ownership costs, and the status of progress addressing deficiencies noted during previous assessments or during operations, such as low reliability." [c]	Monitoring and surveillance for DMSMS issues, using predictive tools and market surveys, are being conducted to identify immediate and near-term obsolescence issues associated with the system BOM. Impact assessment (using actual reliability data and inventory dispositions), resolution determination, and resolution implementation are taking place. Technology road maps and refresh strategies are being factored into DMSMS processes and reviewed for potential updates and adjustments. Case management and the capture of metrics are taking place.

[a] *Logistics Assessment Guidebook*, July 2011, p. 8.

[b] *Logistics Assessment Guidebook*, July 2011, p. 22.

[c] *Logistics Assessment Guidebook*, July 2011, p. 22.

Appendix D identifies a number of specific DMSMS management-related questions for use in support of logistics assessments. As was the case for SE technical reviews, the DMSMS management-related questions offered in the appendix have been designed for use by the DMSMS community to inform DMSMS discussion before the LAs and to highlight DMSMS issues to be addressed during the LAs. DMSMS management-related questions are already incorporated into the checklists for assessments; however, an effort has been made to systematically expand upon them.

[39] *Logistics Assessment Guidebook*, July 2011, p. 6.

3. Prepare: Establishment of a DMSMS Management Program Infrastructure

This section describes the *prepare* step of the DMSMS management program. It encompasses developing a DMP, forming a properly trained DMT to carry out all DMSMS activities, and establishing DMSMS operational processes.

3.1. DMSMS Management Plan

3.1.1. Planning Considerations

The DMP is the key planning document that describes how the regulatory requirement for DMSMS management will be implemented within the LCSP for the program. Formulation of the DMP should begin early in the life cycle—preferably, immediately after Milestone A—because the DMP provides a robust DMSMS management framework for a program.

The PM should consider the following questions when developing the DMP:

- *What is the acquisition strategy and what life-cycle phase should the DMT emphasize for the planning effort?* The answers to these questions are interrelated and affect the near-term objectives of the DMP and the DMT. As the system moves through the life cycle, the DMT's focus may shift from providing government oversight of contractor DMSMS processes and delivery of management products to the government for acceptance to conducting organic DMSMS assessments and sustainment planning. In the Technology Development phase, for example, the government should ensure that the contractor is minimizing obsolescence throughout the contract period of performance by selecting products that avoid or resolve hardware, materials, software, and firmware obsolescence issues. During the Production phase, the government should ensure that the contractor is able to meet production requirements, as well as ensure that the government will be able to sustain the product over the long term. During the O&S phase, the government may want contractor support for DMSMS management and ensure that the system can be sustained until the next upgrade or replacement system. In addition, the contracts in place or expected to be in place weigh heavily when determining the roles and responsibilities of each DMT member.
- *What is the long-term sustainment strategy of the program?* The answer to this question affects the DMP objectives, as well as the composition of the DMT and the availability of technical data. The party ultimately responsible for long-term sustainment must participate in the DMT to ensure that the appropriate groundwork is laid to meet the long-term objectives of the DMP. No assumptions should be made regarding long-term sustainment responsibilities. For example, if the DMT assumes that a contractor will provide sustainment support for the life of the system, and a later decision is made to use an organic depot, the government may not have the appropriate DMSMS data to meet the system sustainment requirements. It is therefore imperative to have exit strategies in place (e.g. contract exit clauses) to ensure both a smooth transition of responsibilities and the availability of technical data throughout the program's life cycle, not just until the end of the contract. Furthermore, government and industry often have different perspectives on long-term sustainment. The contractor usually focuses on the end of its contract.

- *Who are the stakeholders for the robust management of DMSMS issues for the program (including other DMSMS management programs that interact with the DMSMS management program for the system in question)?* The answer to this question determines the composition of the DMT, as well as its members' roles and responsibilities. The answer also affects the communication flows needed to implement the DMSMS management processes that the DMT develops. In addition, the DMT will determine a desired frequency for monitoring and surveillance activities. Finally, the answer helps define the management products that the DMT delivers to its members as a function of the data needed to effectively carry out their roles and responsibilities.
- *What are the near-term and long-term DMP objectives?* At the most basic level, the DMP's objective is to reduce DMSMS cost, schedule, readiness, and availability risks to an "acceptable" level. The specific definition of "acceptable" is a function of the size, complexity, and cost of the system, as well as the current life-cycle stage, the acquisition strategy, the LCSP, and technology refresh/technology insertion strategy. The near-term objectives, however, will drive the composition of the DMT, the roles and responsibilities of the DMT members, the processes and communication flows that the DMT needs to define and develop the necessary data inputs into those processes, and the management products that will be outputs of those processes.
- *What DMSMS management activities are being performed by the prime contractor?* The DMT should not try to duplicate prime contractor activities; the DMP should be aligned with what the contractor is doing in its internal DMP. If the prime contractor is effectively managing DMSMS risk and similar requirements are being flowed down the supply chain, the DMT's role should be focused on oversight. The DMT should not make assumptions about what the prime contractor is or is not doing. The facts can be obtained only from a careful examination of contract language and actual contractor processes. Regardless of the relative roles of the government and the prime contractor in DMSMS management, the government is ultimately the responsible party.
- *What types of processes should be developed and what products are needed to successfully manage DMSMS issues?* Although many general DMSMS management processes and products are transferrable from program to program at a high level, the DMT must ensure that processes and products are tailored to meet the program's specific needs at the working level. The DMT should consider the unique needs of the program, the unique needs of each stakeholder, and the unique flow of communication required among the stakeholders to ensure that the process enables fulfillment of the DMT objectives. In addition, the DMT must consider the data sources necessary to implement the DMSMS management processes and produce the DMSMS management products.
- *Where should the program be reactive and where should the program be proactive?* Nearly everything will become obsolete or unavailable over time. However, not all situations need to be handled proactively. In some circumstances, the risk of impact is low if a program waits until an item cannot be purchased before dealing with the situation. For example, there may be commercially available alternatives to certain parts categories, such as electrical and me-

chanical COTS assemblies and standard industrial parts. Active monitoring may be more important for custom electronic and COTS assemblies.[40]

- *What resources are available to fund DMT operations?* Initial planning should not be resource constrained. However, the DMP objectives, the DMSMS management processes and products, and to some extent, the DMT composition itself may be constrained if sufficient funding is not available.

Programs sometimes use DMSMS intensity levels to identify the current state of their DMSMS management practices and to determine a desired future state for those practices. A higher intensity level indicates a more robust approach to DMSMS management, which implies that a high-performing DMT is actively engaged in doing the following:

- Monitoring critical parts in the system using predictive DMSMS management systems, vendor surveys, and other research techniques
- Overseeing contractor DMSMS management efforts in a comprehensive way
- Assessing readiness, availability, cost, and schedule risks to the program, because of parts or materials obsolescence
- Conducting analyses to determine the most cost-effective resolution, including actions at higher levels of assembly
- Overseeing implementation of resolutions to ensure all stakeholders carry out their assigned roles and responsibilities.

A robust DMSMS management approach does not imply being proactive everywhere. It means being proactive when it is important, for example, when

- the readiness or availability impact of a shortage is acute,
- resolution implementation takes a long period of time,
- the cost of delaying resolution is potentially high, or
- a production schedule is likely to be affected.

In some situations (especially for common mechanical parts) a reactive DMSMS management approach is robust, because many alternatives can be used. Although a robust DMP will be more expensive to implement, the resulting cost savings and cost avoidance throughout the life cycle will be greater and DMSMS impacts on readiness, availability, and schedule will be lower.

Appendix I contains information to help guide a decision on the appropriate target DMSMS intensity level for a program. The DMP should then be designed to achieve that target.

3.1.2. Outline of DMP Contents

The DMP should be signed and approved by senior program leaders to demonstrate their agreement and support for the actions prescribed in the plan. This is especially important when competing for resources.

[40] Custom electronic and COTS assemblies are mission-specific equipment designed by the prime contractor or a subcontractor specifically for the program.

The outline and format for the DMP are not prescribed. However, the DMP should not be a tutorial on DMSMS management. Instead, it should include only what the program intends to accomplish. As a best practice, the DMP should include the following:

- Relevant system-specific information
- Program milestones
- Funded technology refreshment plans
- Design techniques for mitigating DMSMS impacts
- Relevant stakeholders
- DMT structure and membership
- Roles and responsibilities of the DMT and each member of the DMT
- DMSMS training
- Near-term DMSMS program objectives
- Long-term DMSMS program objectives
- DMSMS management approach
- DMSMS management tools, databases, and systems
- DMSMS case management process
- DMSMS contractual language, including requirements flow-down to subcontractors
- Contract exit strategies
- Access to up-to-date parts information suitable for DMSMS management
- System architecture/configuration management
- DMSMS budgeting and funding
- Prioritization approaches
- DMSMS processes
- DMSMS management products
- References to lead-free and counterfeit parts control plans
- Quality assurance
- DMSMS mitigation strategy
- Metrics collection and analysis.

A multi-Service expert system—Systems Planning and Requirements Software, or SYSPARS—is available to assist PMs and PSMs with the preparation of product support, supportability planning, and other acquisition and program management documentation, including the DMP.[41]

[41] See https://www.logsa.army.mil/lec/syspars/.

3.2. DMSMS Management Team

The PM or PSM should charter the DMT and clearly identify and authorize its activities. The DMT should represent both internal and external organizations that provide routine and recurring support to the DMSMS management program. In some cases, it may be appropriate for representatives of other system DMTs to participate if their DMPs and processes interact.

3.2.1. Roles and Responsibilities of DMT Members

The DMP objectives drive the roles and responsibilities of the DMT, as well as its composition. The roles and responsibilities of the DMT are similar for every program, but the level of effort required of the team will depend on the complexity of the program and the severity of the DMSMS issues. In general, the activities of the DMT are to gather the necessary data, develop and implement the DMSMS management processes that require those data, produce the management products that result, report metrics that measure the effectiveness of the DMSMS management program when compared to the defined objectives, and apply continuous improvement processes to DMT operations. The roles should be tailored to meet specific program needs.

The composition of the team will depend on the complexity of the program, as well as on other considerations. For example, some program team members may have multiple duties, which may affect the amount of time they can devote to DMT activities, or they may be assigned multiple roles on the DMT. As another example, if the responsibility for the system will be transferred to another agency or activity midway through the life cycle, the stakeholder who will ultimately bear responsibility for sustainment should participate in the DMT during all phases of the life cycle. The DMT composition may evolve over time. Early in the life cycle, before the critical design review, a partial team may be sufficient.

Ideally, a DMT should consist of the following roles:

- *DMT lead.* The DMT lead is the spokesperson for the DMT and oversees and has the authority to control DMSMS management program operations. The DMT lead is responsible for coordinating DMT meetings, identifying potential sources of funding and funding availability, requesting funding and other resources to support the program, overseeing the DMSMS management support contracts and agreements, interfacing with the configuration control board (CCB), and reporting on DMSMS risks at technical, logistics, and programmatic reviews. This role may sometimes be filled by the DMSMS subject matter expert (SME).
- *Program office representative.* The program office representative represents the views of the PM on the DMT. Normally this person would be the DMT lead.
- *DMSMS SME.* The SME coordinates the execution of DMT management processes and the development of DMT management products. This includes, for example, assessing obsolescence forecasts, processing BCAs, preparing budget forecasts, and presenting solution options to the DMT for discussion and concurrence. In addition, the SME assists with establishing the DMT and with developing and maintaining the program’s DMP as a living document. Furthermore, the SME monitors the effectiveness of the DMSMS management program and recommends ways to continually improve it by capturing and assessing metrics that accurately measure the success or failure of meeting the defined DMSMS management program objectives.

- *Engineering activity representative.* The DMT member representing the engineering function is responsible for managing the incorporation of DMSMS-related technical data into government drawings, technical publications, and documentation. The engineering activity representative provides information to the DMT regarding resource requirements, systems integration engineering, and reliability and maintainability analyses on parts and components selected for use on the system. The engineering activity representative also assesses the suitability and feasibility of proposed technical solutions. Early in the life cycle, the engineering activity representative may also include the prime contractor representative, if that is the source of greatest expertise.
- *Supply support activity representative.* The supply support activity representative is an ad hoc team member who provides his or her organization's viewpoint on DMSMS issues. The team may have several supply support activity representatives, for example, item managers from the Defense Logistics Agency (DLA).
- *Contracting office representative.* The DMT member representing the contracting office is an ad hoc team member who provides guidance and administrative requirements for support contracts and agreements. This person also helps the DMT ensure there is no ambiguity in the contractor's DMSMS management requirements.
- *Prime/subcontractor representative.* Depending upon the terms of the contract, the prime/subcontractor representative ensures that the OEM fulfills its roles and responsibilities with respect to DMSMS management as outlined in the contract. In addition, the prime contractor representative may serve as the DMSMS management lead for subcontractors and present DMSMS issues and risks to the DMT.
- *Foreign military sales representative.* The FMS representative helps optimize DMSMS resolutions by providing information that enables all users to be considered. Mitigating DMSMS issues in a program should account for both U.S.-owned and foreign-owned platforms (obtained through FMS or direct commercial sales), because all of these assets create demands that affect item availability. In addition, cost-related benefits exist in that one user may be able to leverage resolutions being developed by another user. Although U.S. and foreign DMSMS management processes are similar, there are additional considerations in an international situation (technology security, information assurance, International Traffic in Arms Regulations, and so on) The DMSMS SME must interface with the FMS representative and the appropriate international point of contact before taking any actions.

Below are examples of other roles that the DMT could include, depending on the program's chosen DMSMS management infrastructure and objectives:

- Budget office representative
- Maintenance repair activity representative
- CCB representative.

Some roles may be combined, while some of the responsibilities may be either deleted or new ones added over time. The most effective DMT organization should allow for open communication among the team members, whether they are representing the government, the prime contractor, or subcontractors.

An Accountable/Responsible/Consulted/Informed (ARCI) chart is a good way to visually depict the roles and responsibilities of each DMT member. The responsibilities are defined as follows:

- *Accountable (A).* Identifies the individual who is ultimately accountable for the completion of the activity and who has the ability to say “Yes” or “No.” There may be one and only one “A” for a decision or activity at each organizational level.
- *Responsible (R).* Identifies the individual or individuals who are responsible at each level of the organization to execute a specific assignment for an activity. The degree of responsibility is determined by the person accountable. There can be multiple “Rs” for one activity at each organizational level.
- *Consulted (C).* Identifies the individual who must be consulted before a decision or activity is finalized. This is a two-way communication. There can be multiple “Cs” for one activity at each organizational level.
- *Informed (I).* Identifies the individual who must be notified about the completion or output of the decision or activity. This is a one-way communication. There can be multiple “Is” for one activity at each organizational level.
- *Not Informed (N).* Identifies individuals who do not need to be notified about the completion or output of the decision or activity. There can be multiple “Ns” for one activity at each organizational level.

Table 3 is a notional example of such a chart.

Table 3. Notional ARCI Chart

	Role							
Activity	DMT lead	Program office representative	DMSMS SME	Engineering activity representative	CCB representative	Supply support representative	Contracting office representative	Prime contractor representative
Meeting coordination	A	I	C	I	I	I	I	I
Funding requirements	R	A	C	C	N	N	I	C
Future budget projections	R	A	C	C	N	N	C	C
DMSMS monitoring	A	I	R	I	N	I	N	C
DMSMS solution implementation	C	A	C	R,C	R	C,I	I	R,C
Contracting	C	R	I	I	N	I	A	C
Supply support	I	I	C	C	I	A,R	I	C,I

Responsibilities may change significantly, depending on how the prime contractor is being used to support DMSMS activities (see Appendix B).

3.2.2. DMT Training Needs

All members of the DMT should be trained on their role in supporting DMSMS management for the program. Not all members of the DMT are expected to be DMSMS SMEs or reach a targeted competency level; however, the DMT lead should identify minimum training requirements for DMT members on the basis of the DMSMS management approach, available resources, and the roles and responsibilities of each DMT member.[42] The recommended courses are as follows:

- CLL 201, DAU DMSMS Fundamentals
- CLL 202, DAU DMSMS for Executives
- CLL 203, DAU DLA DMSMS Essentials
- CLL 204, DAU DMSMS Case Studies
- CLL 205, DAU DMSMS for the Technical Professional.

Table 4 outlines training recommended for the different DMT roles. The DMT lead may use this as a guide, but tailor it as necessary to meet the specific needs and constraints of the program. The important thing is that DMT members have the appropriate knowledge and skill base to carry out their responsibilities effectively.

Table 4. Recommended DMT Training

Role	CLL 201	CLL 202	CLL 203	CLL 204	CLL 205
DMT lead	X	X	X	X	X
Program office representative	X	X	X	X	
Engineering activity representative	X			X	X
CCB representative	X			X	
Supply support activity representative	X		X	X	
Contracting officer representative	X			X	
Prime contractor representative	X	X		X	X

Although each DMT should have a DMSMS SME, it is not always necessary to find that expertise within the program. Centralized DMSMS SME teams reside at various activities across DoD. These teams have in-house DMSMS management expertise and well-established processes that any program can easily leverage to implement a DMSMS program. In addition to an already established knowledge base and documented processes that enable robust DMSMS management, some of these teams own DMSMS management systems that experienced DMSMS practitioners use to integrate, analyze, and report on DMSMS-related data collected using predictive tools, vendor surveys, and product discontinuance notices (PDNs) received directly from manufacturers. The DKSP has a list of centralized DMSMS SME teams.

[42] If the DMT membership changes, the new members should receive training on DMSMS and on their roles and responsibilities within the DMT.

DMSMS SMEs should have a majority of the following knowledge, skills, and abilities:

- Knowledge
  - Background in logistics management and systems engineering, as well as a thorough understanding of DoD policies and procedures as applied to DMSMS management, design interface, maintenance planning, and the acquisition and sustainment of a system
  - Technical understanding of all logistics elements and SE principles and their impacts upon each other
  - Mastery of DMSMS management concepts and policies sufficient to provide guidance and direction to logistics and engineering personnel on issues related to or affected by DMSMS issues and concerns
  - In-depth knowledge of developing DMSMS management requirements and projecting funding requirements for an effective DMT
  - In-depth knowledge of a DMSMS case tracking system and DMSMS metrics
  - Knowledge of the BCA process in the DMSMS decision process
  - Knowledge of military and contractor supply chains, especially for commodities of focus
  - Knowledge of the concepts, theories, and principles of system design, operations, and support
  - Functional knowledge of the relationship between design interface, maintenance planning, engineering design, and DMSMS considerations necessary to create and establish innovative and effective program policies and procedures for systems as required by DoD activities and authorized FMS organizations
  - Functional knowledge of DMSMS management for the development of agency policy, procedures, and processes for mitigating DMSMS issues
- Skills
  - Skilled in interacting with senior government and industry executives, as well as with other logisticians, engineers, and PMs, both individually and in groups
  - Skilled in resolving conflict and negotiating solutions to complex technical issues
  - Skilled in developing and evolving collaboration among commands and agencies to maximize the attainment of efficiencies to determine best practices and leverage existing processes
  - Skilled in communicating with others to interpret contractual requirements for performance-based logistics (PBL) for DMSMS management support packages
  - Skilled in communicating with others about the prevention of obsolescence of critical components
  - Skilled in communicating clearly and concisely, both orally and in writing
  - Skilled in perceiving relationships and effects between the subject under discussion and related areas of importance and to bring those relationships to the attention of all concerned

- Abilities
  - Ability to provide recommendations to program offices and field support teams to assist with planning and developing their DMP, statements of work, contract language, and logistics assessments
  - Ability to provide focused management and coordination across multiple stakeholders in support of DMSMS management
  - Ability to chair and facilitate a DMT by developing annual goals and agendas and to direct the personnel and programs to meet the established goals
  - Ability to identify, prioritize, and recommend solutions to the barriers that prevent a PM from establishing a robust DMSMS management program
  - Ability to apply advanced concepts and theories to DMSMS issues and tasks so they may be resolved effectively and efficiently
  - Ability to develop and establish DMSMS management processes and guidelines for all personnel to follow.

Appendix A contains a comprehensive outline of DMSMS competency levels.

3.3. DMSMS Operational Processes

A process is any activity or set of activities that uses resources to transform inputs into outputs. Processes have objectives, inputs, outputs, activities, and resources. Two foundational DMSMS processes have already been discussed in this section: develop the DMP and form the DMT. As the DMT develops the DMSMS operational processes, the team must define the basic jobs needed to support the program office or other customers. The team must then define and understand the inputs, outputs, activities, resources, and schedule. In fact, once the operational processes have been developed, key DMSMS management events should be included in the program's integrated master schedule.

Tools are involved throughout all DMSMS operations. The DMT should employ tools to collect, aggregate, store, and report data, as needed, to produce DMSMS management products. The DMT should utilize research tools, predictive tools, logistics tools, BOM analysis tools, BOM manager tools, and configuration management tools. The DMT will need to determine the appropriate tool mix for enabling the intended DMSMS approach.[43] Some of these tools are mentioned later in this section as part of the case management process. A more extensive discussion of tools can be found in Section 4.

It is not necessary for the program to develop or purchase its own tools. DMSMS management systems support many of the defined elements of DMSMS operations. These systems integrate DMSMS best practices, processes, an in-house knowledge base, and many of the aforementioned tool types into a single management system that enables robust DMSMS management. These systems include management databases that trained DMSMS practitioners use to integrate, analyze, forecast, and report on data collected from predictive tools, logistics tools, vendor surveys, PDNs received from manufacturers, and an in-house knowledge base. In addition, these DMSMS

[43] When determining the appropriate tool mix, the DMT should consider the tools already being used by the contractors.

management systems facilitate high-level processes necessary for surveying vendors, processing alert notifications, analyzing BOMs, analyzing data, researching parts, forecasting, budgeting, reporting, managing DMSMS cases, and ensuring quality. These processes are, for the most part, transferrable. Programs can leverage these DMSMS management systems and the associated service offerings to implement a new DMSMS management program. The DKSP contains a complete list of DMSMS tools, management systems, and resources.

DMSMS management processes can be categorized in many ways. Figure 7 shows the scheme used in this document. The DMT establishes and carries out all of the operational processes shown in the figure, but each process is associated primarily with one of the major DMSMS management activities and, consequently, with one of the sections in this document.

The following subsections describe only those operational processes associated with infrastructure, while the remaining operational processes are addressed in the following sections.

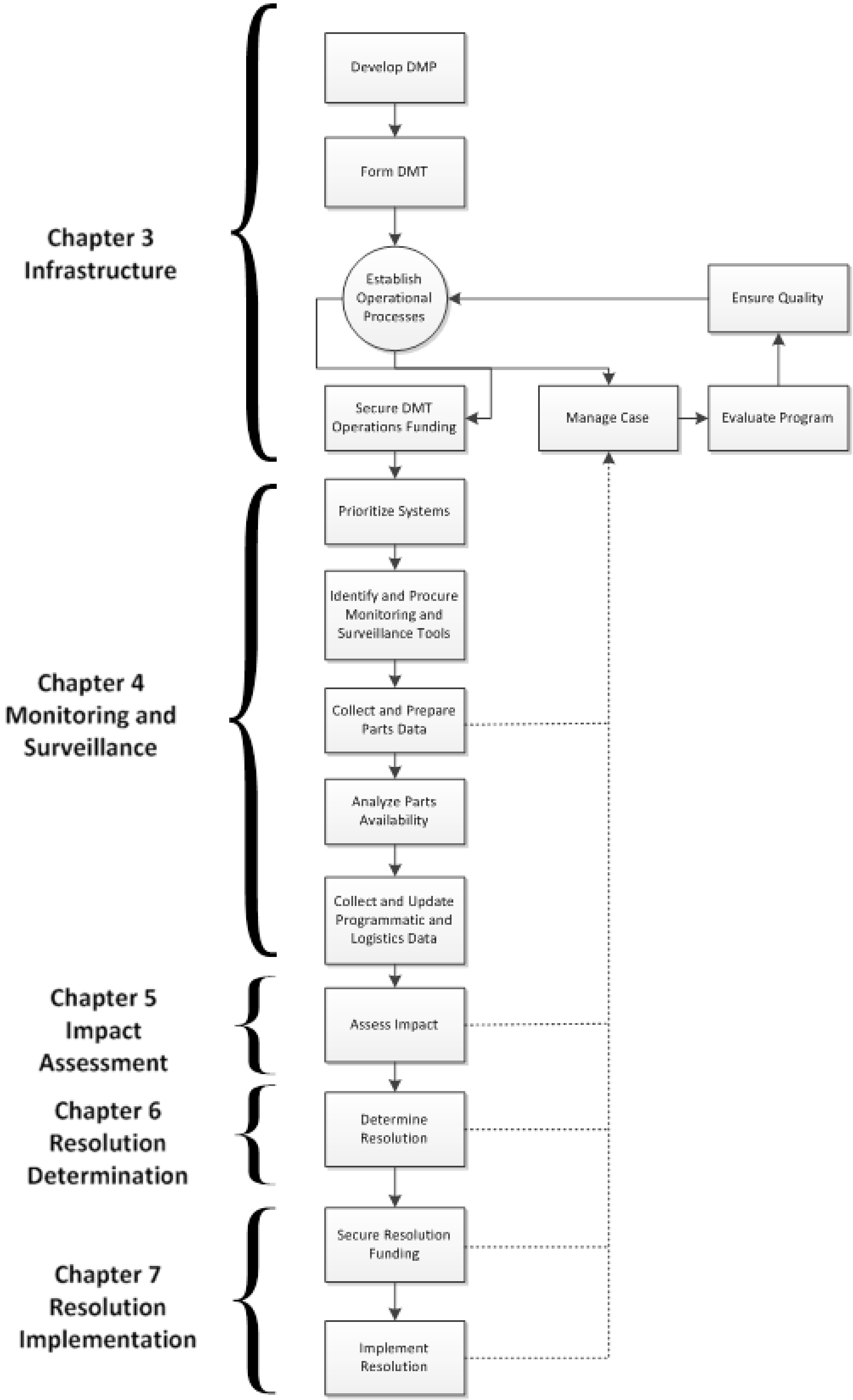
3.3.1. DMT Operations Funding

The budget and funding for DMSMS management processes generally consists of three elements:[44]

- *Support for DMSMS planning and management.* This element includes the following tasks:
    - Attending meetings, including travel, as needed
    - Developing the DMP
    - Agreeing upon, creating, documenting, implementing, and executing processes
    - Agreeing upon the required management products, articulating the required format, and producing them
    - Defining and reviewing metrics
    - Ensuring quality.
- *Data management, research, and forecasting.* This element includes the following tasks:
    - Obtaining parts lists
    - Obtaining DMSMS analysis tools and management systems
    - Analyzing BOMs
    - Researching parts
    - Surveying vendors
    - Processing PDNs
    - Monitoring processes
    - Managing data.

[44] Section 7 discusses funding for implementing DMSMS resolutions.

Figure 7. DMSMS Management Processes



- *Data analysis and reporting.* The following are illustrative activities:
  - Assessing operational impact
  - Reporting (both formal and informal)
  - Analyzing resolutions
  - Managing cases
  - Overseeing implementation.

Beyond start-up costs for developing the DMP, obtaining BOMs, and loading predictive tools, the funding requirements for these activities should be relatively stable. The magnitude of the requirement is contingent upon the DMP and the number of items that the team chooses to assess. The responsible office (often the program office) must program and budget for the resources for these activities. Leadership support and agreement are critical to the success of this effort. Because DMSMS management is not a standalone activity, including DMSMS-related resource requirements in the budgets of other activities, such as parts management, reliability and maintainability, or supportability activities, is often a successful tactic. Maintaining convincing metrics about accomplishments and cost avoidance also help justify budget requests.

3.3.2. Case Management

The purpose of case management is to track and manage DMSMS issues from initial identification to implementation of a resolution and to provide a record of past issues and their respective approved resolutions. To manage DMSMS cases, the DMT should consider the use of a tracking tool or database. The tracking tool or database should support functions such as the following:

- Tracking of numbers for each case for future reference
- Tracking of all appropriate part number information and nomenclature (configuration and vendor parts)
- Selection or identification of a particular DMSMS resolution or set of resolutions for each case
- Determination or assignment of DMSMS resolution costs, cost avoidance figures, and return on investment (ROI)
- Assignment of action items to particular individuals or organizations related to a case
- Tracking of the length of time to identify and resolve DMSMS issues
- Determination of the levels for tracking resolutions, such as
  - “Open”—cases that are actively being worked,
  - “Pending”—cases for which the resolution has been determined and is awaiting final program decision,
  - “Resolved”—cases for which the resolution has been approved and funded and is awaiting final implementation, and
  - “Closed”—cases for which the resolution has been fully implemented and fielded.

Some programs may track a resolution until it is completely implemented and fielded. Other programs may stop tracking a resolution once the determined resolution has been funded, rather than tracking it through fielding, due to the length of time for implementation. Also, depending on the level of detail needed, programs may combine open and pending resolutions. This decision about the level of detail to be tracked should be made when the program case management process is established.

A DMSMS case management report contains the relevant information on DMSMS cases that are opened, pending, resolved, and closed. These reports include a synopsis of assigned priority, potential resolutions, selected resolutions, relevant points of contact, relevant case management metrics as defined by the DMT, and DMT action items relevant to each case. These case management reports are important, because they can be used for publicizing DMSMS successes and sharing data among other DoD platforms. Effective outreach could help obtain funding for both DMT operations and for implementing resolutions to DMSMS issues.

3.3.3. Program Evaluation

The DMT should continually evaluate the effectiveness of the DMSMS management program measured against the defined DMT objectives. Recording and periodically analyzing performance metrics are important elements of this evaluation. Many different metrics can and should be captured for a DMSMS program. The DMT should determine what metrics to use as a basis for evaluation, how to collect those metrics (contractual requirements may be necessary), and how frequently to report those metrics. In addition, a feedback loop is needed so that the DMT can continually improve the DMSMS processes, process inputs, and process outputs. Below are some examples of DMSMS program evaluation metrics:

- Number of DMSMS notifications or cases created
- Number of cases closed
- Number of cases resolved
- Average time to case closure
- Average time to case resolution
- Estimated or actual cost avoidance (depending on data available)
- Percentage of the program robustly managed, based on unit-level BOMs and COTS assemblies in the system (for example, percentage of BOMs and assemblies of the system to be monitored out of the total number of items of the system)
- ROI
- Operational availability deficiencies due to obsolescence that were avoided (for example, when the resolution is put in place, quantify the operational deficiencies that would have taken place if that resolution were not implemented).

To the greatest extent possible, metrics should be focused on leadership concerns. In that way, leaders can be more readily convinced of the benefits of DMSMS management and, consequently, will be more likely to support the DMSMS management program.

3.3.4. Quality Assurance

DMSMS management support consists of complex processes using inputs from diverse sources and producing outputs supplied to customers with varying expectations and needs. Attention to the quality of these processes ensures the consistency and high quality of program support. Therefore, the DMT should operate within a well-defined and functioning quality management system. The DMT should ensure that a quality plan is established, with attention to process documentation, quality controls, meaningful metrics, and timely feedback loops in the areas of quality and process effectiveness. See Appendix H for more information on the quality assurance process.

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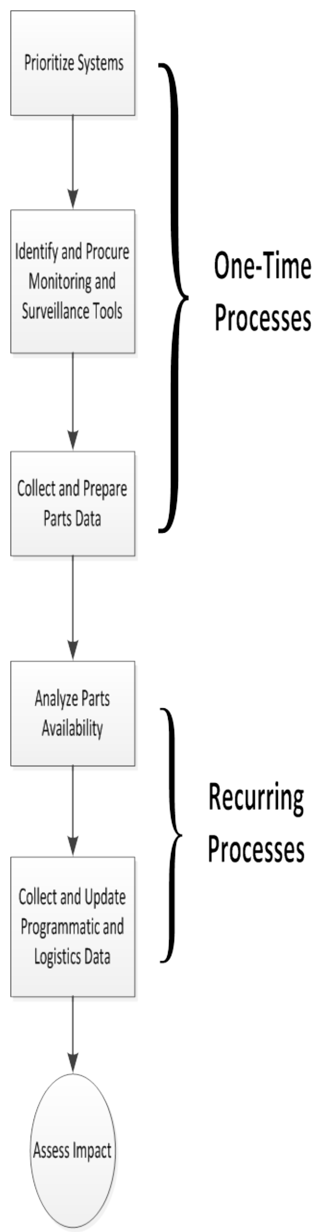
4. Identify: DMSMS Monitoring and Surveillance

Monitoring and surveillance constitute the *identify* step of the DMSMS management processes. This element requires a program to monitor and survey its parts and materials for end-of-life (EOL) notices or other indicators of potential discontinuance. DMSMS monitoring and surveillance should begin as early as possible during the design phase and continue throughout the entire life cycle of the system. This section describes the monitoring and surveillance processes:

- *System prioritization.* This process entails the determination of the scope and focus (for example, which units of the system are of most interest, due to criticality, operational safety, or associated DMSMS-related costs) for the DMSMS management effort.
- *Identification and procurement of monitoring and surveillance tools.* This process identifies and procures the DMSMS predictive forecasting and associated data collection and management tools to support the DMSMS management program.
- *Collection and preparation of parts data.* This process encompasses the collection of BOMs and parts data and the prioritization of parts to eliminate those that can be easily replaced (such as fasteners) from parts availability analysis. In addition, the BOM/parts list is prepared and loaded into a predictive tool for analyzing parts availability.
- *Analysis of parts availability.* This process includes the combination of market research and the use of predictive tools to determine initial, and subsequent, parts availability baselines for immediate and near-term obsolescence issues for the program.
- *Collection and update of programmatic and logistics data.* This process entails the identification, collection, and update of programmatic and logistics data necessary to analyze parts availability and ultimately, to assess the DMSMS impact and determine a resolution.

Figure 8 identifies the one-time processes and the recurring processes associated with DMSMS monitoring and surveillance. For the most part, system prioritization, identification and procurement of monitoring and surveillance tools, and collection and preparation of parts data are one-time processes. However, depending on when the prioritization was done, new data on DMSMS issues may lead to additional systems being given a high priority. The other two processes—analysis of parts availability and collection and update of programmatic and logistics data—recur throughout the duration of the program, when either the program receives a new EOL notice directly, or the output of the program's predictive tools or market research surveys have been updated.

Figure 8. DMSMS Monitoring and Surveillance Processes



4.1. System Prioritization

Robust DMSMS management may require monitoring and surveillance of thousands of parts simultaneously. Prioritizing the scope and focus for the DMSMS management program is crucial for a complex platform, which typically has many subsystems, each with multiple units, which in turn have many assemblies. Prioritization in this process is not a ranking of subsystems to monitor; rather, it is a "yes" or "no" DMT determination of what portions of the system to actively

monitor, when, and at what frequency. Initial prioritization of the portions of the system on which to focus the DMSMS management effort can be based upon the following:

- *Safety.* A top priority for the scope and focus of a DMSMS management program is any part, assembly, or installation containing a critical characteristic whose failure, malfunction, or absence could cause a catastrophic failure, loss, or serious damage resulting in an unsafe condition. Special attention should be paid to aircraft, missiles, rockets, and airborne systems, as well as other systems that involve command, steerage, and propulsion of ships or land vehicles. Similar safety concerns on other systems should be identified by the program offices.
- *Mission criticality.* Another top priority for the scope and focus of a DMSMS management program is any system—whether a primary mission system or an auxiliary or supporting system—for which operational effectiveness and operational suitability are essential to successful completion of the mission or to providing aggregate residual combat capability. Such systems are critical, because if the system fails, the mission likely will not be completed, especially if there is a known single point of failure or a significant impact on the next higher assemblies.
- *DMSMS-related costs.* Any subsystem experiencing or expected to experience frequent or expensive DMSMS-related issues should be monitored. Considerations for identifying subsystems under this criterion, before actual data are available, include unique fit or materials, closed architecture, modified COTS assemblies, high redesign costs, single source, or low reliability.
- *Sustainment strategy.* A system's sustainment strategy reflects the maintenance or support concept of operations for that system. Such strategies consider impacts on system capability requirements, responsiveness of the integrated supply chains across government and industry, maintenance of long-term competitive pressures on government and industry providers, and effective integration of system support that is transparent to the warfighter and provides total combat logistics capability. The DMT should be particularly concerned with these issues if the government is providing sustainment support. If a contractor is required to resolve DMSMS issues, then the DMT's primary role is to oversee the contractor's efforts.

There are several differences in the system prioritization process that vary as a function of life-cycle phase:

- For systems in design and production, actual data may not be available to understand where high cost or frequent DMSMS issues are occurring. There may be only some near-term indications of such areas based upon ongoing monitoring and surveillance activities. These areas are expanded as the system matures.
- Over time, the sustainment strategy may evolve; consequently, the mix of organic and contractor roles may change.

Although not strictly a system prioritization process issue, impact prioritization is affected by life-cycle phase. It is especially important to identify DMSMS issues during design or production, because decisions made during those phases can significantly affect the system's life cycle. Furthermore, when obsolete parts are not eliminated from product designs, higher risk distributors are more likely to be used to obtain components that are no longer in production. This adds to the risk of funding counterfeit parts on DoD systems and in the DoD supply systems.

4.2. Identification and Procurement of Monitoring and Surveillance Tools

The DMSMS management program should identify and procure predictive obsolescence tools and associated data collection and data management tools needed to support DMSMS monitoring and surveillance. Predictive tools may be particularly useful for analyzing certain types of parts, such as electronics; however, these tools have limited capability for other types of parts, such as hardware or COTS assemblies. Most DMSMS predictive tools perform the same core functions of monitoring the availability of electronic components in the BOM and forecasting their obsolescence. Each tool has a set of loading criteria and formats, output report formats, and other information that can be ascertained from the loaded BOM.

The DMT should review all available tools and select the tools for its program based on needs and cost. To select the most appropriate tools, DMT members must understand the capabilities and outputs of each tool and must be confident and comfortable with the final selection.

If a program decides to have the contractor purchase and manage the DMSMS tools, the government must have access to the data reported by those tools, for two key reasons: to allow the government sufficient visibility for effective oversight and to enable it to readily assume DMSMS management responsibilities if DMSMS management roles change.

In addition to being cost-effective, reliable, and user friendly, a predictive obsolescence tool should be able to do the following:

- Manage accurate configurations.
- Enable real-time assessments of availability for components qualified for the system.
- Identify obsolescence issues and specific quantities per affected assembly.
- Identify all potential resolution options.
- Identify aftermarket sources of supply.
- Generate timely alerts on production change notifications and PDNs.
- Enable real-time views of current part availability analysis.
- Rapidly develop obsolescence case sheets, providing streamlined and complete status of obsolete component issues.
- Provide engineers with the data needed to evaluate and implement resolutions.
- Share notes and resolutions across all managed platforms and systems.
- Enhance productivity by minimizing the impact on engineering staffs, while rapidly providing critical data needed for decision making.

A specific tool, alone, will not recognize all parts on a BOM. A recent informal study of two predictive tools found that one of them successfully recognized only 71 percent of the parts being researched by the team,[45] and the other recognized only 72 percent of the parts being re-

[45] The study reviewed all of the systems (ranging from missiles to aviation and in all phases) monitored by the U.S. Army Aviation and Missile Research Development and Engineering Center. On the basis of that review, recognition rates were calculated for the two predictive tools used by the center.

searched. When comparing the availability reported by the two predictive tools, the study found that the tools disagreed regarding the obsolescence status of 4 percent of the parts being researched. There are legitimate reasons for these statistics. In particular, different tools use different algorithms and philosophies in identifying and reporting obsolescence. Also, the electronics industry changes rapidly, and new parts are added daily. Furthermore, update schedules for the predictive tools vary, sometimes resulting in discrepancies in part availability status between tools. Therefore, if funding allows, and if practicable, the program should use more than one predictive tool and, for parts not tracked by predictive tools and for parts that are particularly critical, should do manual research. Regardless of the tools used, engineering analysis and judgment remain key factors in identifying DMSMS issues.

Beyond predictive obsolescence tools, BOM data management tools, configuration tools, logistics data collection tools, data storage and retrieval tools, and report generation tools are all needed for monitoring and surveillance. Selection criteria include reliability, user friendliness, cost, and usability by multiple programs. As discussed in Section 3, DMSMS management systems exist that include both proactive functions and data collection and management functions.

Many tools can assist a program with monitoring and surveillance, as well as with other data management tasks. A list of tools can be found in the DKSP.

4.3. Collection and Preparation of Parts Data

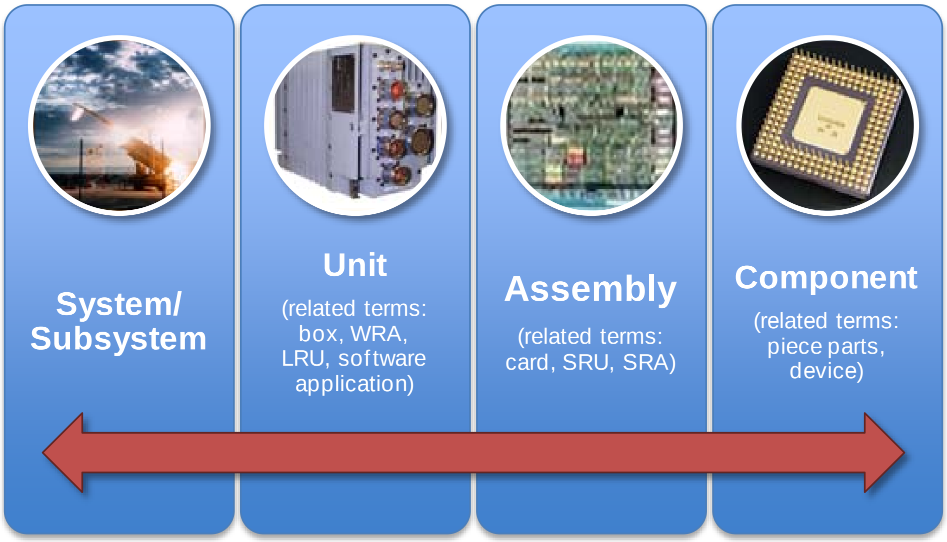
Once the focus and scope of the DMSMS management program has been determined by the prioritization of systems based upon mission criticality, operational safety, and so on, the data necessary to support parts availability analysis and, ultimately, DMSMS impact assessment should be identified and collected. Parts data, including parts lists/BOMs and additional information obtained from market surveys, are used to analyze parts availability, resulting in a list of system parts that have immediate, or anticipated, near-term obsolescence issues.

4.3.1. Parts Data Collection

4.3.1.1. Hierarchy of System Parts

To adequately and cost-effectively address obsolescence for a program, the DMT may have to monitor, assess, and resolve DMSMS issues at different and multiple levels within a system. Figure 9 illustrates the hierarchy of system parts. As one moves from left to right across the figure, the system is decomposed into smaller and smaller parts, from unit to assembly to component. For each of the parts of the system, additional related terms are also provided. So, for example, when a program is referencing the component level, other terms often used to refer to this level of parts are piece parts and device.

Figure 9. Hierarchy of System Parts



Notes: LRU = line replaceable unit, SRA = shop replaceable assembly, SRU = shop replaceable unit, and WRA = weapon replaceable assembly.

4.3.1.2. Different Types of Parts Data

Different types of parts are likely to be incorporated into the design of any system. Therefore, the DMT needs to be aware of how different types of data may need to be collected or even suggest different means of collecting and managing the data. The following subsections contain such information for custom electronics and hardware and for COTS assemblies.

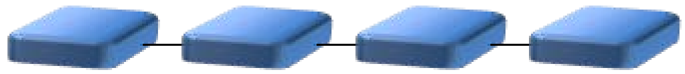
Electronics and Hardware

For electronics and hardware data, a parts list or BOM is an indispensable data resource for robust DMSMS management. Without a parts list or BOM, parts availability analysis, impact assessment, and the continuous prediction of discontinuance by a DMSMS management program would not be possible.[46]

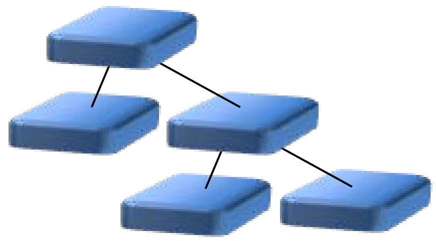
A BOM identifies the materials, components, and assemblies used in making a unit. The list may be in a "flat-file" format or an indentured format. A flat-file BOM is a simple list of parts, while an indentured BOM shows the relationships (generally in a top-down breakout format) of components to assemblies to units to the system. Figure 10 depicts the two formats.

[46] This does not imply that the government must have a BOM. DMSMS management can be performed by the prime contractor. See Appendix B.

Figure 10. Comparison of Flat-File and Indentured BOMs



Flat



Indentured

Because it provides a bigger picture when identifying and weighing resolution options for an identified DMSMS issue, an indentured BOM format is preferred over a flat-file format. For example, when analyzing parts availability, a flat-file BOM would enable the identification of only the number of obsolete parts within the unit; it would not provide any indication of whether some of the parts are on the same assembly. Not knowing the effect of the identified, immediate, and predicted obsolescence issues on the system's parts hierarchy limits resolution options. In some cases, it may be more cost-effective to perform a minor redesign of an assembly, rather than undertaking life-of-need buys of multiple components within that assembly. An indentured BOM enables the program to more readily visualize the relationships of identified obsolescence issues within the system and to use this information to inform the identification and determination of potential resolution options.

In addition to the configuration (indenture) information conveyed through an indentured parts list or BOM, useful parts data pertaining to the components, assemblies, and units of the program's system include the following:

- OEM-approved alternatives
- OEM technical manuals
- OEM DMSMS mitigation efforts underway
- OCM part number
- Sources of active manufacturing
- Actual or projected EOL
- Function (active versus passive, complexity)
- Type (custom, hybrid, proprietary)
- Reduction of Hazardous Substances (RoHS)/lead-free (Pb-free) information
- F3 details.

One of the DMT's first tasks is to obtain the BOMs (probably from the prime contractor via flow-down arrangements through the supply chain) for the system. The best situation is one in

which the government has established a contractual requirement for the BOMs (and for notional BOMs or parts lists during design).[47] When a contractual requirement is not in place, OEMs are often reluctant to release BOMs, due to competition or proprietary issues. However, just because an OEM may be initially unwilling to provide a BOM, this does not mean that one cannot be obtained. Experience has proven that a DMSMS management program may be able to convince the OEM to share BOM data. Below are some examples of ways to pursue access to the BOM:

- The OEM may automatically assume that the program expects delivery of the entire technical data package (TDP). That is not correct. The program needs to make sure that it clearly explains what is being requested; DID DI-SESS-81656 outlines data fields that a program requests (see the DKSP). Ideally, the BOM should be in an editable electronic open-standards-based format. An OEM may not have an issue with delivering this information.
- If an OEM is still reluctant to share the BOM, the program may wish to determine if the OEM may be more willing to share this information directly with the government. In some cases, subcontractors are wary of sharing their BOMs with the prime contractor, but will more readily deliver them directly to the government or a government representative (with a nondisclosure agreement).
- In both of the above cases, the program should illustrate advantages to the OEM from sharing the requested data. Because BOM data enable the program to continually monitor for obsolescence issues, the program will share DMSMS discontinuation notices with the OEM and can assist with researching resolution options, so that both parties (government and OEM) benefit.
- If the program is still not able to convince the OEM to share the required parts data, then the program has several options to consider. First, it may be able to develop a BOM from available data. The DMT can begin DMSMS management if it can at least obtain or create a minimal BOM listing the active parts within the system. With a limited BOM, the DMT can load a predictive tool, identify the status of components, and perform basic parts availability analysis. As it gets better at managing DMSMS problems, the DMT will realize that any redesign or new system acquisition should include the BOM as a contract deliverable, along with the new components, assemblies, units, or systems. It may be prudent for a program to require the procurement of some types of BOM data on any new system acquisition.
- If the OEM requires a program to pay for the BOMs needed for robust DMSMS management, then the program should first determine whether the required data have not already been paid for and received through some other avenue (configuration management, production, provisioning, and so on). In some cases, the program may discover that the OEM is already proactively monitoring the BOM for DMSMS issues. In light of this information and due to funding constraints, a program may choose to leave DMSMS management to the OEM, rather than acquiring and loading the BOMs into its own predictive tool. However, if a program does decide to do this, it must maintain sufficient oversight of the OEM's DMSMS

[47] To understand the data rights, see the original procurement contract and any follow-on contracts. The contracts usually contain specific detail on the data rights for items delivered as contained in DD250 forms. Using product data for government purposes, such as monitoring integrated BOM part numbers for end-of-life warnings, and using product data for competitive reprocurement are significantly different. DoD should attain technical data rights commensurate with the sustainment strategies of the systems used in its global defense missions so that it can ensure they remain affordable and sustainable. For more information about data rights, refer to "Myths of Data Rights" in the *Army Guide for the Preparation of a Program Product Data Management Strategy*, August 2010.

management efforts. This might entail the program requiring the regular delivery of parts availability analysis for the system or of immediate alerts when a DMSMS issue is identified. Because no DMSMS predictive tool is 100 percent accurate, a program may still wish to acquire its own tools and load its own BOMs to minimize the risk of missing a DMSMS issue that could significantly affect the system.

- The DMT can manage the units within the system like a COTS assembly, as described below.

COTS Assemblies

Using COTS assemblies within a system design has several benefits, including reducing or eliminating the risks typical of custom-developed systems. However, COTS assemblies present a unique set of challenges, specifically for the management of DMSMS issues. These challenges are due, at least in part, to the fact that these items are produced for the commercial market. For example, the rapid turnover of COTS assemblies creates unique obsolescence-induced supportability issues for military systems, because OEMs are likely to replace or stop producing COTS assemblies long before the life cycle of a system is complete.

DMSMS management concerns about the incorporation of COTS assemblies in a system design are inevitable. Avoiding DMSMS issues due to the introduction of COTS assemblies in a system design calls for effective relationships among all program participants: the COTS supplier, the system developer and integrator, the DMT, and the buyer (for example, the item manager). The DMT must remember that all COTS assemblies are subject to DMSMS issues, but some particular component classes and COTS assemblies are prone to specific problems. For example, software, central processing units, memory chips, and disks change frequently. These specific COTS classes aside, a degree of obsolescence is always in place in the form of planned minor upgrades or refreshes, typically at the 2- and 4-year marks. Beyond that, a major upgrade—a next generation—should be expected at some time in the future.

Automated DMSMS predictive tools typically do not comprehensively monitor COTS assemblies and similar items like mechanical parts for obsolescence. Further, BOMs for COTS assemblies are not usually readily available[48] and may not be cost-effective to obtain if available. Therefore, a program should periodically survey the OEM to obtain updated information about the parts availability (usually at the next higher assembly) and projected life of the COTS assemblies. Data obtained from manufacturers' websites and market surveys need to also factor in the OEM's internal DMSMS management program and the reliability of data provided by the vendor, including the following:

- Sources of active manufacturing
- Actual or projected EOL
- Function (active versus passive, complexity)
- F3 details
- Warranty information
- Current software and firmware revisions

[48] In contrast, BOMs may be available for non-developmental items designed for the government.

- Information on next-generation products and compatibility
- Duration of support.

More information regarding market surveys and data that can be obtained from manufacturers' websites is provided later in this section.

4.3.2. Parts Data Preparation

By this point, the program has identified and collected all relevant parts data, as well as selected and procured the appropriate DMSMS predictive tools. Before loading the parts lists/BOMs into the tools, the program should take several final steps to prepare the parts data for recurring analysis of parts availability. First, the parts lists/BOMs should be reviewed to identify the parts on which the program's DMSMS monitoring and surveillance activity will focus. For example, the parts lists/BOMs may contain any number of parts (such as fasteners) that do not need to be analyzed with a predictive tool because of the availability of so many alternatives. This review will result in three lists of parts:

- *Components/assemblies to definitely monitor.* These parts include certain parts classes known to have a high propensity for obsolescence issues. These part types include electronic COTS assemblies (networking gear, computers), active components, radiofrequency components, and custom electronic assemblies. This subset of part types generally introduces high risk to a program, if the program chooses not to monitor them.
- *Components/assemblies for which not enough is known to determine the need for monitoring.* If sufficient data are not yet available, including information about the likelihood of obsolescence issues, parts in this category should be considered along with the parts on the "definitely monitor" list, until further evidence proves that they can otherwise be removed from monitoring and surveillance. In addition, some parts do not exhibit a high propensity for obsolescence issues. These parts are usually passive components such as capacitors, inductors, resistors, and electrical and mechanical COTS assemblies (motors, engines). Due to the general low risk of obsolescence associated with these parts, some programs find it cost-effective not to monitor them. However, critical specialty components or high-reliability passive components should be monitored. The DMSMS SME and engineering activity representative should understand the associated risk before choosing not to monitor any such components and should revalidate that decision periodically.
- *Components/assemblies not to monitor.* This subset of part types includes standard industrial parts, such as mechanical components, connectors, cabling, and consumables, which are the most difficult to research and monitor and typically do not present a significant risk, because most of these parts are easily replaced when they become obsolete. Generally, these parts can be eliminated from monitoring. There are some circumstances, however, that warrant a DMT's monitoring these types of parts. The DMSMS SME and engineering activity representative should understand the associated risk before choosing not to monitor such components and should revalidate that decision periodically. Custom fabricated parts (such as fenders or castings) that will no longer be produced after final delivery also should not be monitored, because everyone knows their status.

The DMT should have an obsolescence management strategy for every part. The program should carry forward the "definitely monitor" and "not enough information to determine whether to monitor" parts for availability analysis. The strategy for the "Not to Monitor" parts is to find an

alternative when they become obsolete, because ample replacements are available commercially. Once the parts have been prioritized, the data for the components/assemblies to "definitely monitor" and "not enough information to know whether to monitor" can be loaded into the program's predictive tools.

4.4. Analysis of Parts Availability

When all of the parts are analyzed for obsolescence (as determined via either predictive tool usage or vendor surveys), the magnitude of the program's immediate and near-term DMSMS issues will begin to surface. These parts availability status results represent a snapshot in time and, therefore, must be repeated throughout the life of the system, in response to the identification of new parts obsolescence notices, a market survey, or a regularly scheduled update to the predictive tools. If possible, a program should receive daily DMSMS notifications that pertain to the electronics in the program's systems. Quarterly or annual alerts or market surveys may suffice for COTS assemblies, but may be too late for electronic components, especially if a program has only 30 days to make a life-of-need buy. Update frequency may also differ for different commodity types, based on the availability of information, the rapidity of the technology's evolution, and the risk that the part or material poses to the system and mission.

The following three subsections describe the use of predictive tools and market surveys for analyzing parts availability and the external trigger—PDNs—that prompt a refresh of a program's parts availability analysis.

4.4.1. Predictive Tools

The output of most predictive tools is a report portraying parts availability on a red-yellow-green scale (but no common definition exists of what this color scale represents). Monitoring and surveillance should focus on the following:

- Parts that are no longer available and for which no alternatives are available[49]
- Parts for which discontinuation notices have been issued, but some are still available
- Parts projected to be out of production within 3 years.

Some parts (especially electronic parts) are more readily analyzed using predictive tools. Such parts should, if at all possible, be examined by two predictive tools. If the tools disagree regarding the obsolescence status of a part, then additional manual research is needed to confirm whether or not the part has an immediate or near-term obsolescence issue. If the part does not present an immediate or near-term obsolescence issue, it does not need to be assessed for DMSMS impacts. Even if the predictive tools agree that an obsolescence issue exists with respect to a particular part, then a manual check should be done to confirm that finding.

Predictive tools may not provide an industry obsolescence status for some parts. This may be due to an incorrect part number, lack of identifying information, or the way the tool provider collects

[49] The fact that a predictive tool indicates the existence of an alternative part does not guarantee that the part will work successfully in legacy systems. The conversion of original hard-copy drawings to digital drawings for legacy systems may make it difficult to know why a particular source's part was chosen over another source's part that appears to be similar or the same. The hard-copy drawings may have indicated a difference that was not captured digitally. Therefore, the DMT should check with the engineering authority before concluding that an impact assessment is not needed.

data. Also, the part may be from a manufacturer that the tool does not query. Parts with unknown availability must not lead to a false sense of security. Additional work is needed to determine their availability. It may be that data errors can simply be corrected to enable the predictive tools to forecast part availability. In other cases, manual research may be necessary. For example, the OCM, if known, should be contacted. Otherwise, inquiries should be made down the supply chain until the OCM can be identified and source control drawings can be accessed. If the part number is correct, another predictive tool may be used. Tool providers allow users to submit requests for parts to be added to their library of monitored parts. Certain restrictions apply, but usually, providers will add catalog part numbers at a subscriber's request. Subscribers of these tools should take full advantage of this to reduce the amount of research required for future BOM monitoring and receipt of EOL notifications.

Predictive tools should be used throughout the life cycle. Early in design, they should be used on notional BOMs or preferred parts lists; both are good sources of parts that are likely to be used in production. Early design for new systems is usually based on existing designs being developed by the OEM. The starting point is rarely a predominately blank technical drawing.

4.4.2. Vendor Surveys

Predictive tools may not be able to forecast the availability of some parts (such as COTS assemblies and mechanical items). In these instances, the best way to analyze availability is through vendor surveys. It is helpful to develop a vendor survey questionnaire to manually interact with COTS and hardware manufacturers, establish a database to capture and track the survey information, and determine the frequency to make contact for updates (again, prioritized based on criticality).

Below are some examples of vendor survey information and questions that a program can include in its vendor survey questionnaires:[50]

- Product name
- Company name
- Commercial and Government Entity code
- Part number
- Contact information
- Is this item currently in production? If no, when did production end? If this product is no longer in production, can the government still purchase it? If yes, how many? When is the last date that the product can be purchased? If currently in production, when do you anticipate end of production?
- If you are not currently planning an end of production date for this product, please provide an estimate, based on similar products, past history, technology/component obsolescence, etc. (Keep in mind that this date is used for supply planning purposes only.)
- How long after the end of production will the government be able to have this product repaired? What's the typical cost to repair this item?

[50] Although more questions can be asked, the response rate is likely to be higher if the market survey is brief.

- Once production has been discontinued on the product, how much stock (in time) is typically available for sale?
- When this product is discontinued by your company, will you enter into an agreement with an after-market vendor so that customers can still buy the product? If yes (for this product or for other similar ones), please indicate the name of the vendor and give a point of contact.
- Is there a replacement or a planned upgrade to the product? Is the new item equivalent in terms of form, fit, and function? If so, what is the new product's part number and cost?
- What warranty does the product have? What is the warranty length and can the length or start time be adjusted to allow for integration and deployment? What extended warrantees are available, and at what cost?
- What is the list price of the product and its lead-time?

A key step in developing an obsolescence management strategy for mechanical and COTS-based systems is to compile a list of equipment and parts in the system and group them by OCM (for mechanical parts) and by OEM (for COTS assemblies). With such a list, the DMT can make one phone call to each OCM and OEM to obtain obsolescence information about numerous items. Another helpful hint for a contractor that has been tasked by the government to survey vendors is to obtain a letter of permission to seek this information from the government and share it with the vendor. With this letter, vendors should be more cooperative in sharing information. The program (regardless of whether in-house or contracted out) should decide how often to contact the OCMs and OEMs; the appropriate frequency will depend on the criticality of each system, general life-cycle expectations, and other DMT-determined factors.

4.4.3. Product Discontinuation Notices

The DMSMS management program should receive automated industry obsolescence notices and DMSMS alerts from the selected predictive tools, GIDEP, and DLA. Although overlaps will occur, all three sources should be used to maximize completeness and timeliness. In addition, the DMT should query manufacturers' websites, build relationships with OCMs (similar to the vendor survey relationships), and access other federal supply sources and free government tools to identify data and notifications on parts availability (see the DKSP for more information). The remainder of this subsection focuses on alerts and external triggers for parts availability analysis updates from GIDEP and DLA.

4.4.3.1. GIDEP

A DMSMS management program should become a GIDEP member early in its life cycle. GIDEP is a cooperative activity between government and industry participants seeking to reduce or eliminate expenditures of resources by sharing essential technical information during the research, design, development, production, and operational phases of the life cycle of systems, facilities, and equipment. For complete requirements, and to become a member, see the GIDEP website (www.gidep.org).

GIDEP is a useful tool to support monitoring and surveillance, because it has developed a part batch search routine that permits GIDEP participants to send and compare part lists to the part identifiers in the GIDEP database. Part lists are protected so that only GIDEP operations center personnel will have access. Batch processing is available only to registered GIDEP participants.

Also, as a GIDEP member, a program can get "push mail," which is generated, as a convenience to provide GIDEP participants with an overview of information without having to access the database. If a part or title in the list is of interest, the corresponding document can be retrieved through direct database access. All GIDEP representatives are automatically eligible to receive push mail. Users may also be granted access with their representative's approval. Representatives can either access the push mail registration online to update their profile or to assign distribution to their users. Once users have been granted access to push mail, they can update and change their own distribution or email online. As part of push mail, members can receive weekly summaries that list documents committed to the database during the week cited. The list includes the document number, date, designator, title, and abstract.

Members can also request parts lists that represent all part identifiers (manufacturer, government, specification, drawing, model, base, and national stock numbers) either contained within or cross-referenced to all documents entered into the GIDEP database during the week cited. This allows a program to check its parts against the GIDEP-generated weekly parts list without having to create reports itself. A program may then enter the database to retrieve only those documents of interest to the program.

In summary, GIDEP does not have the ability to predict which parts will become obsolete, but it can provide a program with a no-cost means to find out which parts of interest already have discontinuation notices against them. Programs can also use GIDEP's batch processing as a way to ensure that the program will receive discontinuance notices that match system parts and also may provide the ability to assist with identifying unmatched parts.

4.4.3.2. Defense Logistics Agency

DLA (www.dla.mil) also provides PDN alerts to subscribers—including Military Services, government agencies, FMS customers, and industry (with .mil email accounts and common access card capability)—through its shared data warehouse.[51,52] These DLA-generated alerts contain information not available through GIDEP, such as DLA usage and weapon system coding. For DLA-managed items, additional analyses are done to determine resolution options ranging from requesting users to determine quantities for life-of-need buys to examining options to emulate microcircuits using its Generalized Emulation of Microcircuits (GEM) and Advanced Microcircuit Emulation (AME) programs.[53]

Access to DLA's websites allows a program to search the following:

- *Qualified Manufacturers Lists (QMLs)/Qualified Products Lists (QPLs).* The data provided in this search are updated as changes occur and may contain information not reflected in the hard-copy version. A program's search will always return the latest information available at that time. QMLs/QPLs are also available in the ASSIST Qualified Products Database. DLA updates the lists as necessary and is charged with requalifying vendors every 2 years.
- *Standard microcircuit cross-reference.* This search provides a cross-reference of microcircuits covered by standard microcircuit drawings, MIL-M-38510 specifications, and vendor

[51] The email address to become a subscriber is dmsms@dla.mil.

[52] DLA's Obsolescence Data Repository is a centralized repository for resolution data and information.

[53] See http://www.gemes.com.

item drawings. If a program prefers to use the cross-reference data on a local computer, a standard microcircuit lookup table can be downloaded.

- *Military specifications (MilSpecs) and drawings.* This website provides courtesy copies of documents managed at DLA. If a program cannot find a document here, it may not be managed at DLA. For a complete list of all DoD MilSpecs, refer to DLA's document automation and production service.
- *Standard microcircuit drawings.* A list of standard microcircuit drawings is available to download.

4.5. Collection and Update of Programmatic and Logistics Data

Programmatic and logistics data, along with the results of the parts availability analysis, support the DMSMS impact assessment process and, ultimately, resolution determination. The data should be refreshed regularly (as changes are made to the systems being monitored) to ensure that the most up-to-date data are used for DMSMS impact assessments and program decision making. In some cases, the data may be updated with the receipt of EOL notices for a part or set of system parts or with the update of predictive tools or vendor surveys.

The data collection process differs slightly as a function of acquisition phase. Early in the design phase, parts data may be notional and based on a preferred parts list. Programmatic data may have less certainty early in a program. Predicted reliability data should be used until better data can be derived from operational use. Actual logistics data will be available only during sustainment.

Logistics and programmatic data may be acquired from the program office, logistics databases, item managers, OEMs, and depots (contractor and organic). Those data enable the DMSMS management program to consider thorough DMSMS impact assessment, whether or not the obsolescence issues discovered affect the system and program negatively, when that impact may occur, and which mitigation resolution is most feasible and cost-effective.

The following are among the types of programmatic data a DMSMS management program may consider collecting:

- Acquisition phase
- Planned number of units
- Unit modernization plans or technology insertion plans
- Technology refresh or insertion plans.

Actual logistics data may be available only if a system has already entered the sustainment phase. Logistics data, however, should be considered a factor in DMSMS impact assessment from earlier phases in the life cycle, based upon predicted reliability data. Below are some examples of the types of logistics data a DMSMS management program should seek to collect:

- Average demand
- On hand
- Due in/due out

- Procurement lead-time
- Repair philosophy
- Cost
- Back-orders and how long items have been back-ordered
- Unserviceable
- Measure of reliability.

The existence of logistics data for the system should enable the program to identify those components, assemblies, and units of the system that present potential sustainment issues and those that do not. This data can then be compared to the parts availability analysis results during impact assessment to determine the risk presented by a particular obsolescence issue.

5. Assess: DMSMS Impact Assessment

An old logistician's proverb—which begins with "for want of a nail the (horse) shoe was lost" and ends with the kingdom being lost, "all for want of a nail"—illustrates that the lowest-level part in a system's hierarchy can affect the entire system. Consequently, a DMSMS impact assessment—the *assess* step—examines the potential effects that a DMSMS issue, at any level of a system, may have on cost, schedule, readiness, and availability. Most DMSMS issues result in a combination of these effects and ultimately all if left unaddressed:

- Cost impacts may be experienced in any stage of the life cycle. The impact is measured as (1) the additional cost that must be paid to resolve the issue; (2) the change in support costs (it will cost the program less if reliability is improved); and (3) the difference in the cost of parts before and after resolution. This third element of cost may be positive or negative, depending on the resolution pursued. If a more expensive alternative part is used, then the cost will be higher.
- Schedule impacts are usually associated with the design or production elements of the life cycle, because obsolescence may delay design or production activities.
- Readiness and availability impacts normally occur during sustainment. DMSMS issues may affect the mission capability of a system, or they may prevent the system from being used altogether.

The purpose of the impact assessment is to answer three questions:

- Should a resolution to the problem be pursued?
- Which problem should be addressed first?
- At what level should a resolution be applied?

An impact assessment should be done when, for example, the program receives a PDN, a change occurs in production units or spares, or a scheduled update of the material availability differs from the baseline.

At this point in the DMSMS management process, data have been collected to help provide answers to the above three questions. The remainder of this section describes the specifics of the data and analysis needed to determine the impact of the shortages. As a best practice, as much data as possible should be gathered to increase the rigor of the analysis. However, in many cases, some of the data may not be available. The DMT should do the best job possible with the data it has. When assumptions are used to compensate for missing data, the results of the analysis will be subject to greater uncertainty.

5.1. Data Needs

Every program is unique, and the criteria established for assessing DMSMS risk are specific to the program's priorities. Regardless of the approach to the overall assessment, four types of data are needed: programmatic, availability, criticality, and logistics.

5.1.1. Programmatic Data

Below are the different types of programmatic data needed for an impact assessment:

- *Life-cycle phase.* If the program is in the design or production phase, the overall life-cycle risk is significant, and emphasis on obsolescence issues at this point will have a significant impact on the total ownership cost of the program. However, an obsolescence issue discovered in the sustainment phase may not be as significant if the program is scheduled for disposal or if the replacement system is ready to be fielded. Industry tends to be interested in collaborating with DoD to solve an obsolescence issue during the design and production phases of acquisition; however, such collaboration can be difficult once the production line has gone cold.
- *Planned technology insertions/refreshes for the subject part/assembly and the next higher unit.* This information is important for an obsolescence issue at any point in the life cycle, because it presents an opportunity to eliminate the requirement for the problem part. It is important to understand whether the planned technology insertion/refresh is funded. If no resources are programmed, then technology insertion/refresh is unlikely to occur. It is also important to understand that DMSMS management is not the driver of technology insertion/refreshment. DMSMS management simply leverages this information to determine risk and, where appropriate, to recommend a resolution option. However, DMSMS issues can affect the technology refreshment's scope and schedule both positively and negatively after they are initially established.
- *Planned end of system life.* EOL data are used for inventory-related calculations. If the system is in design or production, the system EOL may not be known. Even during sustainment, the EOL may be uncertain, because of unplanned service life extensions, which in turn affect inventory requirements and may have potential DMSMS impacts. If the service life is extended, DMSMS situations with no operational impact before the extension may have a significant operational impact because of the extension. Nevertheless, the only approach is to base DMSMS impact assessments on official plans.
- *Number of systems in use over time through the end of system life.* This number is used for inventory-related calculations. If the system is in design or production, only near-term numbers may be available.
- *Planned average operating hours per system.* This number is used to help calculate demand for the part. If the system is in design or production, future average operating hours may not be available. In that case, it may be possible to make estimates based upon historical data of similar systems. The duty cycle must also be taken into account.

5.1.2. Availability Data

Availability data are needed at the part, assembly, and unit levels. Availability should be identified at the lowest level possible, with an assessment of the impact at the next higher levels to better understand the risk and to help identify the most efficient cost resolution option. The DMT should differentiate between items that are currently unavailable and items forecasted to be obsolete in the near term (within 2 or 3 years). If authorized substitutes are available, there is no current obsolescence risk.

5.1.3. Criticality Data

Like availability data, criticality data are needed at the part, assembly, and unit level. The first process in the *identify* step (Section 4) is to prioritize systems according to their mission criticality and safety-related features. Those same criticality factors apply in impact assessments. Furthermore, parts criticality is often determined by the criticality of their function. Examples of parts with critical functions are microprocessors, microcontrollers, memory, application-specific integrated circuits (ASICs), and field programmable gate arrays. Finally, the cost of the item is a criticality factor.

5.1.4. Logistics Data

Programs managed and repaired organically can have access to logistics data, assuming the data are captured and archived. Each Service has a logistics management system and item managers who have access to and understand logistics data. The contractor will have the data for programs that employ contractor logistics support; the government should arrange to have access to this information via contract requirements and deliverables. The following are examples of logistics data:

- *Demand for the parts, assemblies, and units with DMSMS issues.* This primarily applies for items in sustainment, unless the same parts are used in the same way on other systems in the inventory.
- *Reliability of the parts, assemblies, and units with DMSMS issues.* This should be the same as the demand data for items in sustainment. When in design or production, when no demand data have been collected, the manufacturer's stated reliability may be used, but it introduces more uncertainty into the impact assessment.
- *Inventory for the parts, assemblies, and units with DMSMS issues.* Inventory may be found in the service depot (either contractor or organic), production facility, and DLA facilities. It is important to identify the portion of the inventories earmarked for the system in question versus other platforms. Data on inventory due in, backlogged orders, and the length of time on back-order are also relevant. If the system is in design or production, inventory is most likely available from contractors.
- *Maintenance philosophy for the parts, assemblies, and units with DMSMS issues.* Some items may be reparable, while other items may be disposed of when they fail. The availability of or the development of a source of repair can reduce the risk that all of these elements must be investigated.

5.2. Assessment of the Effects of a DMSMS Issue

Understanding the overall risk of an obsolescence issue depends on understanding when the issue will affect the system. This can be accomplished only through an understanding of the logistics position of the items within the system. An analysis of the logistics and programmatic data provides a snapshot in time of current inventory levels and usage rates in order to identify the time frame available (sometimes referred to as days of supply) to identify and implement a resolution. The ability to develop a resolution—within the time frame of availability levels and while a replacement item is available—is directly related to the risk of experiencing some negative impact as a result of a DMSMS issue.

To determine the potential for a future shortage of a particular item, the DMT must estimate the future demand for the item and determine whether the existing stocks (including items due in and items on back-order) will meet that demand. Mathematical methods, accepted by the logistics community, are available for calculating future demand.[54] These models may need to be applied to the next higher assembly. If the subject part will be removed from the system by a planned technology insertion, then the period of requirement ends when the part is replaced.

Once the demand is established for the period required, the DMT can simply subtract the demand from the available stock to determine if and when the shortage will affect the system. Estimating the future demand for parts is risky, due primarily to two key assumptions that must be made: projected future operational hours and reliability. The relative risk varies from decision to decision, but it is real and should be expressed to higher level decision makers when proposing resolutions. The risk introduced by assumptions is always higher before a system is deployed, because no reliability data based on actual operations are available.

Given this understanding, answers to the three impact assessment questions can be developed.

5.2.1. Should a Resolution to the Problem Be Pursued?

One way to answer this question is to identify when a resolution should *not* be pursued. Clearly, no resolution is needed if enough parts are on hand to meet all future demands. However, because the level of "all future demands" is never certain, the level of risk should be considered, as illustrated in these three cases:

- *Case 1.* If the system is in sustainment and there have never been demands for the item facing a DMSMS issue, then there is a low risk for not pursuing a resolution.
- *Case 2.* If the system is in sustainment and calculations show that enough inventory of the item is on hand to last until the system is retired or until a technology refresh replaces the item, then the risk of not pursuing a resolution is low, but should be evaluated further. Reliability data are an extremely useful input in the assessment of risk at any level in the configuration: the higher the reliability, the greater the availability of the item and therefore the lower the risk of an obsolescence impact. For example, if a circuit card assembly seldom has to be replaced or repaired (highly reliable), obsolescence issues at the part level will not be as high risk as an obsolescence issue on a card that is continually being repaired or replaced. This information, if available, should be used in the overall assessment. If the EOL date for the item is uncertain and the item is in high demand, a best practice is to keep it on the list of problems to be addressed, but with low priority. Conversely, for items with a known EOL date and low-demand items, the risk of not pursuing a resolution is relatively low.
- *Case 3.* While a system is in the design or production phase, a constant supply of parts is usually required. The rare exception is when there is a high degree of confidence that all parts needed for production and sustainment have already been procured. The uncertainty of such an analysis would be enormous.

5.2.2. Which Problem Should Be Addressed First?

A step-by-step process can be used to prioritize problems on the basis of their impact on the program. Several ways exist to develop such a prioritized list. The example here is based on

[54] Many articles are related to this topic; one good source is http://src.alionscience.com/pdf/POIS_APP.pdf.

knowledge of piece-part electronics, circuit card assemblies, and the black boxes the circuit cards populate. A similar approach for assessing risk of mechanical assemblies, materials, and COTS assemblies can be derived from these steps.

The steps below are based on assessing the impact of circuit card obsolescence issues given knowledge of the devices (piece parts) on the card. These steps include general statements, such as rank by "x" or adjust the rankings as a function of "y." There is no set formula for these rankings and adjustments. They are based on the experience of the person making the assessment:

- The first step considers both an analysis of piece part availability and the results of the calculation of the time frame until impact using the logistics data and the programmatic data. The order in which availability and logistics analyses are evaluated is determined by the risk assessor. Initially, the cards could be ranked by some combination of the total number of obsolete parts per card, the number of obsolete mission- or safety-critical parts per card, and the number and distribution of unique parts. The rankings could then be adjusted by the days of supply and the average monthly demand for both the parts and the card if the system is in sustainment. If the system is in design or production, reliability data, if available, could be used for the average monthly demand. Inventory levels would be the contractor's stock level.
- The second step is to adjust the rankings based on the near-term obsolescence risk for the parts and the card, the near-term obsolescence risk for the critical parts on the card, and the number of sources for the parts on the card. These data could be generated from the use of predictive tools.
- A third step is to adjust the rankings based on the maintenance philosophy for the parts and the card. If the circuit card is repairable and the obsolete parts are highly reliable, then the risk of the part causing the card to be unavailable is not as great as if the card is a throw-away and no more cards can be produced, due to an obsolete part (even if it is reliable). For example, a repairable circuit card with critical obsolete components may not rank as high risk if the inventory levels of the circuit card are high and the usage rate is low, whereas a card not considered highly complex may be a greater risk based on low inventory levels and high demand rates. The bottom line is that no matter how simple the card, if a spare is not available, then the unit is out of commission. On the basis of this additional logistics information, the priority of risk of the cards in a given unit may change. In design or production, this step might not affect the rankings very much, but the factors addressed are a consideration.
- A final step is to examine programmatic data concerning product improvement plans or other mitigation efforts already underway. If a modernization plan calls for the replacement of the unit or if a refresh of any of the circuit cards is planned, the risk priority may change yet again. For example, if a circuit card assembly is identified as high risk with low inventory levels, but a replacement unit is scheduled to be fielded, the risk may not be as great. The time frame for fielding and the ability to support the card through other means until that time may reduce the risk and therefore the priority of the card. These factors would probably not have much effect for a system in design or production.

If information is available about the electronic piece parts that populate a unit, but no structure is available to understand the breakdown from the unit to the card level, then the above four steps are completely analogous to Case 1. Only the risk at the part level and this translation to the unit level can be evaluated. The number of obsolete components, the complexity of any obsolete components, the near-term obsolescence risks, and their complexity, along with logistics infor-

mation at the unit level and the programmatic data, will identify the risk. For example, assume the flat file of parts contains 100 unique items. The availability analysis identifies no current obsolescence issues; however, several critical part functions are predicted to be obsolete in less than 2 years. The unit was just fielded, with production to continue for 2 more years and no near-term plan to replace it. In this situation, the near-term obsolescence elevates the risk of the unit, but the DMT has some time to plan the resolution options. Evaluating the availability of alternates for the high-risk components and working with the program and the prime contractor to develop a path ahead will reduce the DMSMS risk of this unit.

The same four steps could be used for assessing a COTS or a mechanical assembly for which part data are unlikely to be available. However, the analysis would be much less granular. Instead of using predictive tools, the DMT would need to derive availability data from vendor surveys. For step one, the availability data would simply be that the assembly is obsolete and the logistics data would be similar to the above. Step two would consider just the near-term obsolescence risk for the assembly, and steps three and four would be analogous to the above. For example, assume the supplier survey indicates that the box will be available for another year and that a replacement is planned for when the box is discontinued. However, this replacement is not backward compatible; therefore, some nonrecurring engineering is required and, possibly, some testing to evaluate the use of the new unit in the system. From the logistics input, the DMT determines that the demand rate is low, with enough inventory to support the item for another 18 months as long as the demand rate does not increase. The risk may be assessed as low, given the availability of a replacement and the current inventory levels.

In another case, only one manufacturer supplies ball bearings for aviation platforms. The Industrial Capability Assessment (ICA) of the manufacturer indicates both financial and work force well-being. However, the ICA also indicates that the manufacturer has limited capacity to surge and that all aviation platforms across the Services utilize this one source of ball bearings. If current inventory levels indicate a 6-month supply at the current operating tempo, and if DoD plans to increase the operating tempo, the ball bearings could be a high-risk item for availability (material shortage) even though not obsolete. The supplier might have problems meeting delivery schedules if multiple systems also experience an increase in operating tempo. If an additional source for these bearings is being developed, but qualification of the new supplier is still 2 years out, this manufacturer and this item would be considered medium risk and monitored. Evaluation of the increase in flying hours, along with reliability of the bearings, can identify possible future shortages.

5.2.3. At What Level Should a Resolution Be Applied?

If a system will be affected by a DMSMS issue, the DMT should determine where in the part's hierarchy to apply the resolution. For example, the subject part may be one of many parts within its hierarchy that have DMSMS issues. In such cases, it may be expeditious to replace or redesign the assembly rather than resolve the problems with each individual part. The same factors should be considered in this analysis:

- Number and difficulty of DMSMS problems in the parts hierarchy
- Reliability of parts in the hierarchy
- Expense of repair within the hierarchy compared with redesign or replacement
- Life cycle of other parts in the hierarchy

- Potential for enhancing mission capabilities by redesigning or replacing parts.

Most of these factors can be analyzed by the DMT if sufficient data exist. The importance of integrating part availability data with logistics and life-cycle data cannot be overemphasized when analyzing the impact of a DMSMS issue. The first factor is largely a numbers game. If the cost to implement numerous DMSMS resolutions exceeds the cost to redesign the next higher assembly, then the redesign should be considered.[55] The second and third factors are similar, in that one must compare the cost of continued operation of the existing part to that of implementing and maintaining a new part. This calculation is more involved, but in the end, it is a simple evaluation of which resolution provides the most bang for the buck.

The fourth factor requires a more subjective judgment, because part life cycles are not a strictly objective measure and because educated guesses are required to predict DMSMS problems. One must look at various sources of information and determine if the risk of future obsolescence and its accompanying costs exceed the benefits of resolving known problems now. This analysis is often the basis for planning technology refreshes and may result in a decision to resolve the DMSMS problem for a limited time (life-of-need buy).

The last factor will require the input of other program, and potentially higher level, personnel. If future mission demands require new equipment or different capabilities, it may be expeditious to implement those features now rather than wait.

[55] A single item may be a constituent component in multiple higher level assemblies. This may change the cost calculation, because multiple higher level assemblies may need to be redesigned. The most cost-effective option could be a combination of resolutions at the item level and at higher levels of assembly.

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6. Analyze: Resolution Determination

This section discusses the *analyze* step, specifically, it explains how to find the best resolution option. The resolution determination process is iterative; it is updated as new issues are identified and prioritized. Typically, new items to be resolved are added every DMT meeting. The following subsections identify the cost elements associated with estimating implementation costs, identify and define resolution options, and describe the approach for determining the preferred resolution option. The method is the same whether the DMSMS issue is related to hardware, materials, software, or electronics.

6.1. Resolution Cost Elements

To determine the best resolution, a program must first understand that resolution's total implementation cost, which is the sum of all applicable cost elements associated with that resolution. For example, a resolution may require anything from simple drawing and technical manual updates, to full development and testing of new designs to be implemented in a system. If the actual costs for particular cost elements are known, those costs should be used to develop a more accurate account of the costs required to implement a resolution or series of resolutions. Actual costs give a program the most accurate account of the funding required to mitigate obsolescence and is an important metric.[56] Although using actual costs for resolutions is preferred, actual costs may not be readily available, and obtaining actual costs may be cost prohibitive. Therefore, each program should develop average costs for each applicable cost element.[57]

When determining the most accurate average cost for each element, a program should use various factors, such as the following:

- Historical testing and qualification cost data of previously implemented resolutions for like equipment
- Historical testing and qualification cost data of similar programs with like equipment
- Historical development and redesign costs of like equipment within or outside the program.

In addition, averages are affected by the type of part, commodity, population, and operating environment. The type of part may be raw material, components, or assemblies. The commodity could be electronics, mechanical, electrical, or computer. The population, or number of parts, can have a large effect on costs, due to economics of scale. Finally, the operating environment will make a large difference in testing and certification requirements for approving and qualifying new parts into a system. Operating environments may be aviation, shipboard, space, or ground.

[56] Over time, this metric can be referenced for projecting budget requirements for implementing solutions. See Section 7.

[57] A future version of the SD-22 will contain information on average costs using this cost element approach. Previous versions of the SD-22 provided average costs for different resolution types. These averages did not consider all of the applicable cost elements. Consequently, budgets based on these averages usually underfunded resolution implementation.

The following cost elements should be considered when determining the total cost for resolving a DMSMS issue:

- Engineering, engineering data revision—cost of modifying drawings and other data to reflect the new configuration
- Purchase of engineering, design, or technical data—cost of purchasing technical data required for support
- Qualification of new items—research and evaluation cost generated in choosing a new item
- Revision of test procedures—cost of updating test procedures to accommodate any new testing requirements of selected solution
- Software changes—cost of updating software because of the selected solution and including software updates to test equipment
- Start-up costs—nonrecurring engineering costs to develop production or repair capabilities
- Testing—cost of testing requirements for the selected resolution to ensure system compatibility
- Tooling, equipment, test equipment, or software—cost of repairing and maintaining equipment
- Computer programs/documentation—costs of new software and documentation to support the new item
- Interim support—contractor cost to maintain a product until a permanent resolution can be implemented
- Item cost—cost to procure the item for the entire life cycle
- Manpower—cost of maintenance personnel needed to support the resolution for the life cycle
- Spares—cost to procure spares for sustainment
- Supply/provisioning data—cost to update logistics data to ensure support of selected resolution
- Support/test equipment—cost to provide the repair center with any required support or test equipment
- Technical manuals—cost to provide any manuals and documentation to repair centers
- Training/trainers—cost to develop and maintain training for the new equipment.
- Any other costs as required.

The prevalence of counterfeit parts and the use of Pb-free solder in the electronics industry also affect the costs and risks to resolve a DMSMS issue. When a DMSMS resolution option involves purchasing an electronic part from an unauthorized supplier, additional testing must be done to ensure that counterfeit parts do not enter DoD's supply chain. Therefore, the average testing cost must be included. (See Appendix E on counterfeit parts and DMSMS.)

The impact of Pb-free solder is more complex. It is not easy to know whether an alternative part uses Pb-free solder. However, certain critical DoD applications require that tin-lead (SnPb) solder be used. This adds a technical constraint on the acceptability of certain resolutions. Further-

more, if Sn-Pb solder is a requirement, then additional costs may be incurred to detect and mitigate any use of Pb-free solder. Such additional costs should be factored into the cost element averages. (See Appendix J on Pb-free electronics and DMSMS management.)

6.2. DMSMS Resolutions

Many different types of resolutions exist for resolving an obsolescence issue. These resolutions fall into three broad categories: existing material (logistics), substitutes (engineering), and redesign (engineering). These broad categories indicate the level and amount of research required to implement a resolution. As a program progresses through the various resolution categories, the amount of research and number of cost elements required to implement a resolution increase. Resolutions under the existing material (logistics) category require actions to secure availability of existing supply. Substitute (engineering) resolutions require engineering involvement to qualify or implement. Redesign resolutions usually require all aspects of engineering and qualification to implement new or highly modified equipment. Table 5 contains the standard definitions of each type of resolution, in order of complexity. Table 6 identifies the cost elements that apply to each resolution; "X" indicates a cost element that is likely to be part of the listed resolution and may need to be considered when evaluating costs.

Table 5. DMSMS Resolution Options, Definitions, Solution Types, and Examples

Resolution	Definition	Examples
No solution required	No solution required, because existing stock contained in government or contractor-maintained inventories will satisfy future demands for the product. This is often the result of planned technology refresh, redesign, or system retirement.	It is determined that sufficient stock of an item exists in current government or contractor-maintained inventories to support the system until its next technology refresh.
Approved part	The obsolescence issue is resolved by the use of items already approved on the drawing and still in production.	Research indicates that the drawing includes a reference to another approved part that is still available. Supply is directed to procure the other approved part.
Life of need buy	A sufficient quantity of the item is purchased to sustain the product until its next technology refresh or the discontinuance of the host assembly. Because this resolution uses an approved item, no testing or drawing changes are required. The source of supply can be residual stock from the original manufacturer, shelf stock from distributers, sponsor-owned material, etc. Costs for packaging, storage, and transportation should be considered in the BCA for selecting resolutions. This is sometimes referred to as life of type buy, bridge buy, or lifetime buy.	On the basis of historical usage rates, it is determined that 165 diodes are required to sustain the system until it is decommissioned. Sufficient inventory of the discontinued part is then purchased from an approved distributor and stored for use as needed.

Table 5. DMSMS Resolution Options, Definitions, Solution Types, and Examples

Resolution	Definition	Examples
Repair, refurbishment, or reclamation	The obsolescence issue is resolved by instituting (1) a repair or refurbishment program for the existing item or assembly, whether through a depot repair, a repair contract with the original manufacturer, or support from a third party or (2) a reclamation program to reclaim items from marginal, out-of-service, or surplus materiel. Costs for restoring reclaimed materiel as a result of electrostatic discharge damage, handling damage, and heat damage from unsoldering should be considered.	A program has sufficient items or assemblies to support the system, if they are refurbished. A private company is identified that has this capability, and a contract is awarded to repair these assets for the systems remaining service life. Hybrids are salvaged from an earlier configuration of the NHA, repaired, and used for future repairs on higher assemblies. Because of scrap steel shortage, it was difficult to maintain a source for high explosive munitions bodies. A process was developed to decontaminate and mill surplus munitions projectiles.
Extension of production or support	The supplier is incentivized to continue providing the obsolete items. This may involve long-term agreements to procure specific quantities of parts. One-time costs may be associated with setting up this resolution. Those costs should be included in any cost and cost avoidance calculations.	The DMT works with the manufacturer to resolve any obsolescence problems with a COTS assembly's piece-parts or raw materials, so the original COTS part can still be manufactured. The government obtains the COTS assembly BOM from the OEM, resolves piece-part obsolescence, and then provides the needed parts to the OEM as government-furnished material to facilitate continued manufacture and repair. The DMT works with the manufacturer to extend the warranty or support period, thus extending the useful life of the product.
Simple substitute	The item is replaced with an existing item that meets all requirements without modification to either the item or its NHA and requires only minimal qualification. Typically this implies use of a commercial item or non-developmental item that is a fit, form, and function substitute. Associated costs are largely administrative. This is sometimes referred to as an alternate.	The original part number from TI is purchased from a source not identified in control drawings. One OEM is purchased by another, and drawings must be changed to reflect the new source. The technical data package of an intrinsically suitable, but different, item (for example, a higher-reliability version or an existing part) is evaluated. A rebadged COTS product is discontinued by its vendor, but the source item is still available from its OEM under a different part number. The deployed version of an operating system is no longer supported. The support version is installed as an upgrade and meets all of the current requirements. A previously emulated device (e.g., from DLA's GEM program) is substituted for the original part.

Table 5. DMSMS Resolution Options, Definitions, Solution Types, and Examples

Resolution	Definition	Examples
Complex substitute	A replacement item that has different specifications, but requires no modification of the source product or the NHA, is researched and validated. The substitute may be the result of a redefined military requirement.	An optical coupler approved in the Source Control Drawing (SCD) is no longer made. An engineering search finds four couplers with similar characteristics. After testing, two are approved for the application. The suggested sources table in the SCD is changed to authorize the new parts. The current operating system is obsolete. The replacement operating system does not meet all the specifications of the current version and must be thoroughly tested. A redefined military requirement allows for the use of a substitute item from a commercial source. A special fabrication project in an organic facility is initiated to develop and produce an item.
Development of a new item or source	A replacement product is developed that meets the requirements of the original product without affecting the NHA. Nonrecurring engineering or other development-related activities will likely be required. The new product may be developed by emulation, reverse-engineering, designing a replacement based on the original manufacturing designs and processes, or designing a different product based on the original or new requirements. The manufacturing source for the new item may be the original manufacturer or a new source.	A VME card is discontinued by its original manufacturer. Another manufacturer is contracted to purchase drawing packages, manufacturing equipment, and production rights to continue production of the card. A manufacturer is approached to purchase specifications and production rights to resume production of a component that was discontinued by the original manufacturer. The firmware for a circuit card is no longer available and must be rewritten using different tools. DLA's GEM program creates a device that emulates the original device.
Redesign–NHA	The affected item's NHA must be modified. Only the NHA is affected, and the new design will not affect anything at a higher level in the system.	An obsolete component for which a viable F3 replacement cannot be found requires a redesign of the circuit card on which the component is found. The operating system of a single board computer is obsolete and no longer supported by the manufacturer. Policy dictates that it can no longer be used on DoD systems. The new version of the software will not run on the existing hardware. A replacement board that runs the new version of the operating system is available and will not require changes to other equipment. Some of the associated software must be modified to accommodate the new operating system. A missile's analog range correlator was extremely difficult to build. A digital range correlator was designed to replace the analog unit as part of planned technology refreshment. Some design changes beyond the range correlator itself were involved.

Table 5. DMSMS Resolution Options, Definitions, Solution Types, and Examples

Resolution	Definition	Examples
Redesign–complex/system replacement	A major assembly redesign affects assemblies beyond the obsolete item's NHA and may require that higher-level assemblies, software, and interfaces be changed.	Aircraft radar was replaced to use a different operating frequency. Many obsolescence issues were eliminated in the new design. The operating system of a server must be replaced due to policy changes. The new operating system will require hardware changes to multiple hardware and software configurations.

Table 6. Applicability of Cost Elements to DMSMS Resolution Options

	Existing material (logistics)				Substitute (engineering)			Redesign (engineering)		
Cost element	Approved part	Life of need buy	Extension of production or support	Repair, refurbishment, reclamation	Extension of production or support	Simple substitute	Complex substitute	Development of a new item or source	Redesign–NHA	Redesign–complex/system replacement
Research, Design, and Engineering (cost to find and qualify a resolution)										
Engineering, engineering data revision						X	X	X	X	X
Purchase of engineering, design, or technical data				X			X	X	X	X
Qualification of new items						X	X	X	X	X
Revision of test procedures				X			X	X	X	X
Software changes							X	X	X	X
Start-up costs (aftermarket, etc.)			X	X	X			X	X	X
Testing				X		X	X	X	X	X
Tooling, equipment, test equipment, or software				X			X	X	X	X
Integrated Logistics Support Costs (costs to implement)										
Computer programs/ documentation				X		X	X	X	X	X
Interim support								X	X	X
Supply/provisioning data						X	X	X	X	X
Support/test equipment				X			X	X	X	X
Technical manuals				X		X	X	X	X	X
Training/trainers				X			X	X	X	X
Item cost (optional)[a]		X		X				X	X	X
Manpower (optional)[a]				X						
Spares (optional)[a]				X				X	X	X
Other (as required)	X	X	X	X	X	X	X			

[a] If optional costs are used for one solution, they must be used for all other resolutions considered in a business case.

6.3. Selection of the Resolution

DMSMS management processes do not stand alone. They operate in the context of normal program office business processes. Therefore, determining which resolution to implement has two components. The first component is guided by the program office's organizational structure, hierarchy, and chain of command; for example, all DMSMS management may be under the cognizance of a reliability and maintainability organization. The second component, which is the subject of this subsection, is methodological; its processes determine which DMSMS resolution options to recommend.

The resolution determination process uses various outputs from monitoring and surveillance and impact assessments that determine if and when an issue will affect the operational availability of the system. The resolution process also considers the requirements to transition from one program life-cycle phase or contract to another. For example, resolutions in the design phase may include short-term actions until a longer term option can be implemented in the production phase. Also, some DMSMS issues in the sustainment phase may not require a resolution, because the items may be highly reliable or because enough items are in stock to support the need until the system EOL. Figure 11 illustrates the major activities/tasks of the resolution determination process.

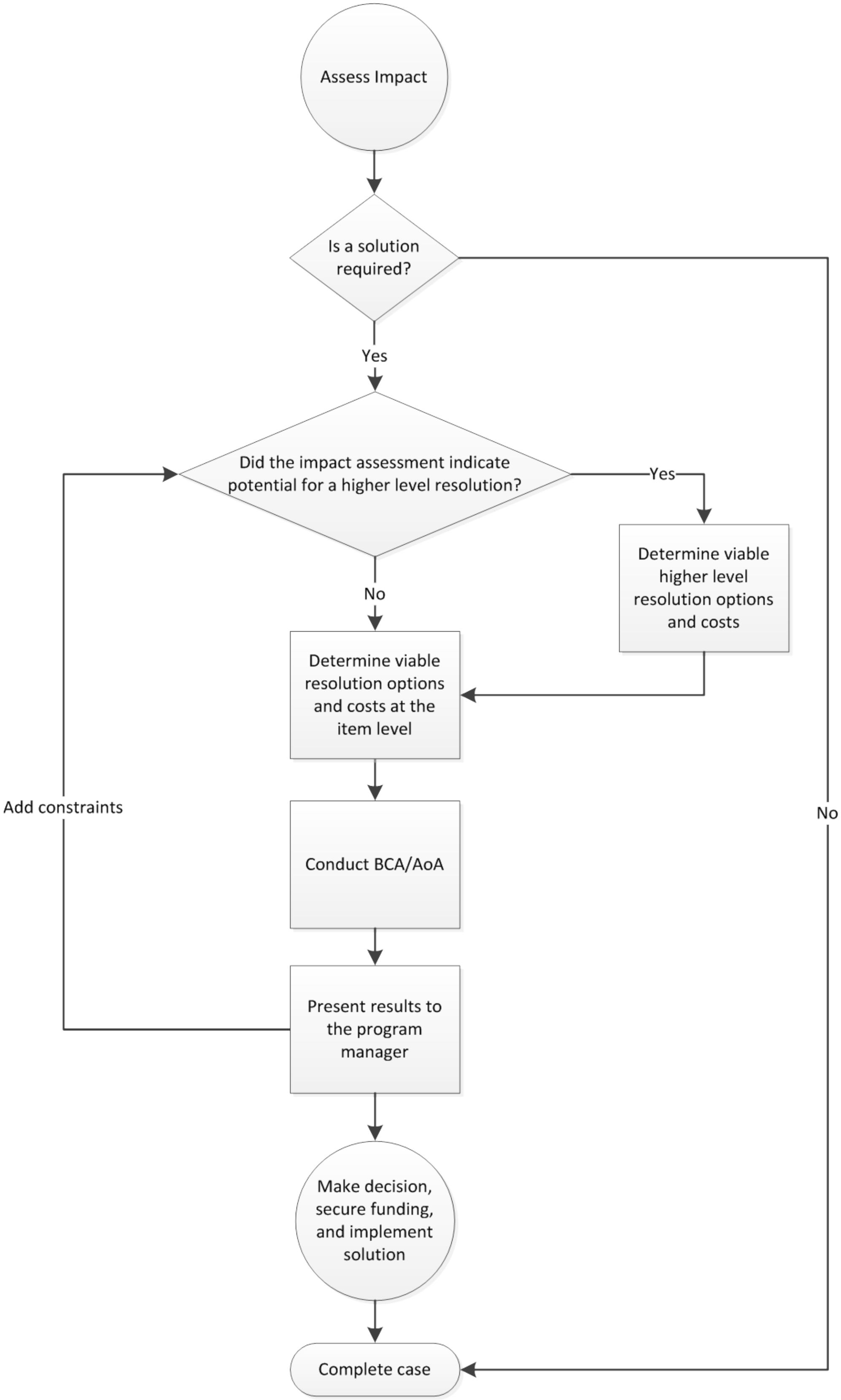
If the impact assessment indicates that a resolution is needed, one or more of the resolutions listed in Table 5 can be applied to any type of DMSMS problem. They account for mechanical resolutions, material resolutions, software resolutions, and electronic resolutions.[58] Although implementation may vary drastically for different types of issues, the overall resolution determination process is the same. Not all resolutions can be applied to a given DMSMS problem. Only those that can be applied are considered viable. For instance, most of the resolution options are not viable for a forged impeller body that has become obsolete; the only viable resolutions may be the identification of a new source or redesign. However, the process to determine the viable resolutions is the same, whether the problem is a circuit card assembly or a specific chemical used in the manufacturing process that has become obsolete because of environmental restrictions.

As resolutions become more complex, their implementation becomes more costly.[59] The list of viable resolutions is built by going through Table 5 from top to bottom and determining the feasibility of each option. Many of the factors used to analyze the operational impact should be used to help determine which resolutions are viable. The overall resolution determination process should consider all viable resolutions at the lowest level of indenture possible and, if the impact

[58] The National Defense Stockpile should be a consideration for a DMSMS issue relating to raw materials. The raw materials may already be stockpiled, or they may be added to the stockpile in the future. For more information, see the Strategic and Critical Materials Stockpiling Act (50 U.S.C. §98 et seq.) and the *Strategic and Critical Materials 2011 Report on Stockpile Requirement*s, January 2011.

[59] A life-of-need buy may appear to be the least costly and simplest option to implement. However, a number of obstacles must be crossed to use this solution. Per 10 U.S.C. § 2213, a waiver process must be used to procure goods that will result in more than 2 years of operating stock. Also, contractors cannot typically be obligated to procure stock beyond the life of their contract, so the government would need to procure and maintain a stock of the needed item. Also, because reliability and end of system life are estimates, accurately determining the quantity of an item to buy is nearly impossible. These obstacles may result in the determination that a life-of-need buy is not a viable option unless it would be used as an interim resolution until another alternative is implemented.

Figure 11. DMSMS Resolution Determination Process



assessment indicates a resolution at a higher level of assembly may be preferable, at higher level assemblies. In some cases, a resolution at a higher level will have a higher ROI, because it may resolve numerous issues at once or improve reliability significantly.

All viable options (including the status quo) are then analyzed further using either an analysis of alternatives (AoA) or a BCA to determine which resolution or set of resolutions gains the best ROI.[60] A BCA is a formal, structured approach for examining the costs, benefits, and risks of different alternatives. It requires effective background research and data collection and management. It also requires a thorough understanding of the quality and completeness of the data and of any assumptions made.

The standard criterion for comparing alternatives on an economic basis is net present value (NPV), the discounted monetized value of expected net benefits (benefits minus costs). NPV is computed by assigning monetary values to benefits and costs, discounting future benefits and costs using an appropriate discount rate, and subtracting the sum total of discounted costs from the sum total of discounted benefits. For DMSMS resolution alternatives, the one with the lowest NPV is preferred, because the benefit of mitigating the DMSMS condition—that is, avoiding negative impacts on system operational readiness—is the same for each alternative.

An AoA is a simplified version of a BCA. An AoA does not require the amount of detailed analysis of a BCA to determine the most viable resolution. Typically, an AoA is used in place of a BCA when a low cost and risk of the resolution can be estimated accurately up front without an in-depth analysis.

Both an AoA and a BCA should account for NPV costs to the end of the phase or contract and should determine the best follow-on resolution.[61] When possible, options to the end of need should be considered. Cost avoidance is also a factor in both an AoA and a BCA. Cost avoidance as it relates to DMSMS resolutions is defined as the difference between the cost of the selected resolution and the next viable resolution. For example, if the only two viable resolutions are a complex substitute or a redesign, then the cost avoidance would be the difference between the estimated redesign costs and the complex substitute costs. However, as another example, if a complex substitute, the development of a new source, and a redesign were all viable resolutions, then the cost avoidance would be the difference between developing new source and using a complex substitute.

Once the program has identified the implementation cost and cost avoidance for the viable resolutions, the program can calculate the breakeven points and ROI to determine which resolution is the most cost-effective. Risk factors should then be used to determine which resolution results in the best overall option. All identified risks associated with the resolutions should be captured and a proper weighting factor should be associated with each risk. Some risks will require a higher weighting factor than others. The following are among the risks to consider:

- Technical—risk associated with the ability to develop or implement a resolution while still maintaining performance within the specification
- Supply chain—risk associated with the financial viability of the resolution provider that will be maintaining the capability

[60] A future version of this document will include average values for DMSMS cost elements to calculate ROI.

[61] For a life-of-need buy, the DMT should consider whether it must purchase a minimum quantity. If that quantity is greater than the expected need, the program should try to identify other potential users as partners.

- Financial—risk associated with the availability of funding required to implement a resolution within a specified time period
- Schedule—risk associated with implementing a resolution before operational availability is affected.

Application of these risks in the decision-making process is subjective. In some instances, a high-cost resolution with low risk is preferable to a low-cost resolution with high risk. For example, testing and qualifying an alternate part that uses technology similar to that in the obsolete part may not be the best choice, because there may soon be a shortage of that alternate. Instead, it may be better to develop a substitute part using more current technology.

When the DMT has determined the best resolution, the PM must decide whether it is acceptable and determine whether the funds and resources are available for implementing that resolution. In some cases, feedback from the PM may require the DMT to repeat the resolution determination process. For example, the PM may impose new resource or time constraints, or may even bring up the possibility of a new product improvement effort.

Some decisions may involve multiple resolutions sequenced over time for implementation. This allows a program time to implement the resolution(s) with the best ROI if barriers exist at the time of notification. For example, if a circuit card assembly with an ASIC is going obsolete and the impact on operational availability is projected to occur within 6 months (based on stock, demand, and reliability information), the DMT may determine that the resolution with the best ROI is to develop a new source of supply. However, if developing a new source will take at least 1 year after qualification, the DMT will need another resolution to cover the development time; for example, if stock is still available, then a life-of-need buy could be implemented.

7. Implement: Implementation of DMSMS Resolutions

The DMT's role does not end when a PM makes a decision regarding which resolution option to pursue. The final step of the DMSMS management process is implementation. In the *implement* step, the DMT should be involved in two final processes: identifying a source of funding for implementation of the preferred resolution and overseeing that the required actions to implement the preferred resolution are taken.

In some cases, contracts with the prime contractor (during design and production) or a logistics provider (during sustainment) may include a requirement for the contractor to fund DMSMS resolutions. (Appendix B contains more information on contracting.) This situation is complex:

- If the contract requires the contractor to buy additional parts to resolve a DMSMS issue, the contractor will normally be concerned only with demands up to the end of the contract period of performance. However, depending on its relationship with the government, the contractor may be willing to support the program "on risk" to provide resolutions beyond the contract period of performance. The government should not assume that this will always be the case, nor should it expect the contractor to buy enough items to last until the end of need without additional funding.
- If the contract requires the contractor to resolve DMSMS issues, the contractor may not fund the most cost-effective resolution from the program's perspective. The contractor will determine the resolution based on its own business case calculations. However, depending on its relationship with the government, the contractor may factor the government's long-term needs into the calculation, assuming the contractor is made aware of those needs. If the program included, in its request for proposals, a requirement for the contractor to fund the most cost-effective resolution from a program office perspective, the contractor would be forced to bid a much higher price to compensate for risk. Consequently, the program should be prepared to negotiate with the contractor on which resolution option to implement and be prepared to provide additional funding if warranted. These negotiations are enabled by a strong government/industry relationship and full government awareness of the DMSMS services provided by the contractor.

As discussed in Section 2, effective technology management will help minimize the cost and readiness impacts of DMSMS issues.

7.1. Resolution Funding

Although the program is responsible for comprehensive planning for DMSMS resources and securing implementation funding, the DMT is often asked to assist. A program may not know the specific DMSMS problems that will occur in a given year, but experience has proven that every program in sustainment will face multiple DMSMS problems annually. Furthermore, experience has also proven that failure to mitigate those problems will lead to unacceptable performance, degradation of system reliability and availability, and increased costs. Consequently, when developing current and outyear budgets, a program in sustainment can use historical data to develop an expected scenario for annual DMSMS problems to be resolved. To develop a scenario for DMSMS issues expected during design or production, the program should consider the contractor's next-generation road maps, information from manufacturers, the age of the technology in

active electronics components, and relevant experience with similar systems. By using the cost elements discussed in Section 6, the PM can determine the average costs to resolve those problems and estimate resource requirements. The DMT can assist with this process. Finally, these estimates can be included as part of future budgets or incorporated in the program's technology road-map funding.

ROI and cost avoidance metrics can be used to gain support for the budgets necessary to resolve expected problems. These metrics may be used to project future savings due to the implementation of the resolutions. If decision makers can be persuaded to accept the estimate of both future cost and future cost avoidance, the cost avoidance estimates can be used to offset (to some extent) the cost of implementing the resolutions.[62] Consequently, future budgets may not need to be as high as originally estimated. Because cost avoidance will occur sometime in the future, near-term budgets will not be able to take credit for any offsets.

Stakeholders understand that average budgets, which are based on the best available data, will almost always be either too high or too low. Because DMSMS management is not a standalone process, there will be opportunities to utilize any extra funding for other reliability, maintainability, or supportability issues. If program resources are not sufficient to implement a preferred resolution, other alternatives are possible.

One such alternative is DoD's value engineering (VE) program. VE is an organized, systematic approach that analyzes the functions of systems, equipment, facilities, services, and supplies to ensure they achieve their essential functions at the lowest life-cycle cost, consistent with required performance, reliability, quality, and safety.[63] Typically, the implementation of the VE process increases performance, reliability, quality, safety, durability, effectiveness, or other desirable characteristics. VE has been used to mitigate DMSMS issues from two perspectives: funding and methodological.[64]

From a funding perspective, a VE incentive (VEI) clause is included in most supply/service contracts when the contract price exceeds $150,000. A VE change proposal (VECP) is a proposal submitted to the government by the contractor in accordance with the VEI clause. A VECP proposes a change to the contract that, if accepted and implemented, provides an eventual, overall cost savings to the government with a substantial share of that savings contributing to the contractor's profit. It provides a vehicle to reduce acquisition and operating costs, while increasing the contractor's rate of return. Typically, the contractor pays the nonrecurring costs associated with the VECP and is reimbursed from the savings. To ensure that savings can be shared, the VECP must meet two primary requirements:

- It must require a change to the current contract under which it is submitted.
- It must provide an overall cost savings to the government after being accepted and implemented. (A VECP could result in increased unit cost, but reduced O&S cost. Thus, there would be an overall savings to DoD.)

[62] This is more difficult when different sources of money are involved.

[63] Office of Management and Budget, *Value Engineering*, Circular A-131, May 1993 (available at http://www.whitehouse.gov/omb/circulars_a131).

[64] See *SD 24*, *Value Engineering: A Guidebook of Best Practices and Tools*, June 2011 (available at http://ve.ida.org/ve/documents/SD-24-VE-Guidebook.pdf), Chapter 8.

From a methodological perspective, the VE process can augment the *analyze* step in DMSMS risk management, as illustrated in the following actual example. Obsolescence issues emerged for the Theater High Altitude Air Defense missile. The issues involved multiple subcontractors and various components. The major and minor redesign efforts recommended to address the obsolescence problems would have resulted in high costs and negative schedule impacts for the program office. The DMT used VE to evaluate each redesign proposal and determine if other mitigation efforts could be employed to overcome the obsolescence issues. A VECP was implemented to mitigate the obsolescence and minimize redesign cost without adverse schedule impacts. Total 3-year cost avoidance was calculated to be $21.2 million.

The following external funding programs, at both the DoD and Service levels, represent other potential resource options for DMSMS resolutions.[65,66] Most of these funding sources have a periodic project solicitation, but some do not. Projects may or may not be accepted off cycle. In some cases, the solicitation is directed at government program offices; in other cases, the solicitation is directed at industry. The focus areas for the project solicitations are defined by the funding programs themselves, on the basis of their understanding of DoD needs. Although a program with DMSMS issues can communicate its needs to the funding programs, to obtain funding, the proposed DMSMS resolution must be aligned with the mission, requirements, restrictions, and goals of the funding programs:

- *DoD and Service manufacturing technology (ManTech) program.* The ManTech program is codified in Title 10 §2521 of the United States Code (U.S.C.) as a requirement for each Service and Component.[67] This is DoD’s primary program for investing in next-generation manufacturing processes, materials, or technologies, but it also has the mission of “development and application of advanced manufacturing technologies and processes that will reduce the acquisition and supportability costs of defense systems and reduce manufacturing and repair cycle times across the life cycles of such systems.” Thus, DMSMS resolutions that require producibility improvements or a new manufacturing capability can seek funding through ManTech, particularly if repair cycle time and support costs can be reduced. The DoD ManTech program is a joint-Service research and development (R&D) program with appropriations in OSD, Army, Navy, Air Force, and DLA. Each Service or agency programs its investments separately, but plans jointly through the Joint Defense Manufacturing Technology Panel. Annual solicitations from each Service and OSD are released, and all proposals must contain clear transition paths and have service support from the transition target PM.
- *Defense Production Act Title III program.* This program’s mission is to “create assured, affordable, and commercially viable production capabilities and capacities for items essential for national defense.”[68] Production capabilities that would otherwise be inadequate are transformed to support the material requirements of defense programs in a timely and affordable manner. Title III focuses on materials and components that could be used across a broad

[65] Programs that apply to only a single service are not included.

[66] DMSMS practitioners should also be aware of congressionally established programs that are not included in the DoD Presidential budget, e.g., the Industrial Base Innovation Fund (received funding in FY 2009–12), the Rapid Innovation Fund (received funding in FY11), and the Defense Rapid Innovation Program (received funding in FY12). These congressional programs are not discussed in this document.

[67] For more information, see https://www.dodmantech.com/.

[68] For more information, see http://dpatitle3.com/dpa_db/.

spectrum of defense systems. The capabilities of defense systems depend upon the availability of materials and technologies.

The program can respond to material shortages using unique authorities to accomplish four objectives:

- Create, maintain, expand, protect, restore, or modernize the production capabilities of domestic suppliers whose technologies and products are critical to the nation's security.
- Increase the supply, improve the quality, and reduce the cost of advanced materials and technologies.
- Reduce U.S. dependency on foreign sources of supply for vital materials and technologies.
- Strengthen the economic and technological competitiveness of the U.S. defense industrial base.

Title III provides a set of broad economic authorities, found nowhere else in law, to incentivize the creation, expansion, or preservation of domestic manufacturing capabilities for technologies, components, and materials needed to meet national security requirements. The goal is not the production of materials or items themselves, but the creation or expansion of the industrial capacity to produce these items and materials. Title III mechanisms can include

- purchases/purchase commitments (not commonly used),
- installation of production equipment,
- development of substitutes (most commonly used via R&D contracts), or
- loans/loan guarantees (not used since 1992 by memorandum of understanding with DoD General Counsel).

- *Foreign Comparative Testing (FCT) program.* The FCT program's mission is to test items and technologies from foreign allies with a high-technology readiness level to determine whether the items could satisfy U.S. military requirements or address mission area shortcomings and could do so more quickly and economically than would otherwise be possible.[69] The program has reaped substantial savings by avoiding R&D costs, lowering procurement costs, reducing risk for major acquisition programs, and accelerating the fielding of equipment critical to the readiness and safety of U.S. operating forces. Although the aim of the FCT program is to improve the U.S. Armed Forces' operational performance, this leveraging of foreign R&D has benefited the U.S. taxpayer. In addition, the FCT program has served as a catalyst for industry teaming arrangements, which have been productive for both U.S. and foreign industries in an increasingly competitive global market, helping to build a robust U.S. defense industrial base. Foreign items are nominated for inclusion in the FCT program by a sponsoring organization within DoD. The OSD Comparative Technology Office funds testing and evaluation; the Services fund all procurements that result from a successful test. DMSMS resolutions that have foreign involvement can use this program to qualify technology or components for procurement.
- *Defense Acquisition Challenge (DAC) program.* The DAC program, initiated by the 2003 Defense Authorization Act, provides opportunities for introducing innovative and cost-saving

[69] For more information, see http://www.acq.osd.mil/cto/programs.html.

commercial technologies or products into DoD acquisition programs.[70] Furthermore, the DAC program is especially designed to give small and medium-sized companies the opportunity to introduce new technologies and inject innovation into DoD programs. To do so, the DAC program provides any person or activity, within or outside DoD, the opportunity to propose alternatives, known as "challenge proposals," to existing DoD programs that could improve performance, affordability, manufacturability, or operational capability of the systems acquired by that program. The program can fund the selection, testing, and insertion of the production-ready technologies into DoD systems, but must prove cost savings and readiness improvements, which would include many DMSMS efforts. The DAC program is focused on reducing life-cycle or procurement costs, enhancing standardization and interoperability, promoting competition by qualifying alternative sources, and improving the U.S. military industrial base. The program uses annual solicitations to request challenge proposals, which usually require a government and industry partner to ensure successful transition. The DAC program requires a commitment from the program of record to procure the technology if the proposed challenge alternative is successfully developed and tested.

- *DLA sustaining engineering program.* DLA Land and Maritime's sustaining engineering program is a means to secure funding for proposed efforts to upgrade items of supply; address obsolescence, component-level reliability, and maintainability issues; or develop new or improved items to replace existing inventory.[71] Sustaining engineering proposals are judged on the basis of the following criteria:
  - Involve an item managed by DLA Land and Maritime
  - Have demonstrated potential for ROI of at least 10:1 over the anticipated life cycle of the system
  - Make a positive impact on operational readiness
  - Make a positive impact on administrative or procurement lead-time
  - Make a positive impact on item demand
  - Make a positive impact on unit price
  - Make a positive impact on overall cost of ownership of the supported end item/life cycle
  - Reduce field/depot maintenance actions
  - Improve competitive position and sourcing issues.

[70] For more information, see http://www.acq.osd.mil/cto/.

[71] For more information, see http://www.aviation.dla.mil/ExternalWeb/UserWeb/AviationEngineering/Engineering/Sustainment/whatissustainingengineering.asp.

- *Army, Navy, and Air Force working capital funds (WCFs).* WCFs are revolving funds used to operate each Service's supply system. The funds generate adequate revenue to cover the full costs of its operations and to finance the fund's continuing operations. WCF logistical operations projects may be used to resolve supportability deficiencies that result in increased cost or mission degradation. Examples of the beneficial results of such projects are mitigation of obsolescence; improvement of reliability, maintainability, and supportability; and reduction of the life-cycle costs of secondary items. Each Service has different mechanisms for obtaining WCF resources:
  - The Air Force has no Air Force-wide programs.[72]
  - The Navy has a logistics engineering change proposal (LECP) program. Projects must be related to reliability or maintainability and designed to reduce support costs while maintaining or improving safety and performance. The project must break even in 7 years. If the project is selected, the LECP program will cover the costs of the engineering change proposal (ECP).[73]
  - The Army has four different types of WCF projects, each with different criteria:[74]
    - The Operating and Support Cost Reduction (OSCR) program is designed to "save the field money" by reducing secondary item acquisition costs, extending the life of the item, and reducing the number of events (removals or repairs) and the cost per event. OSCR promotes life-cycle cost savings and avoidance in the field by redesigning, prototyping, and testing spare parts for fielded systems. OSCR projects involve an individual item or assembly of items, prototype, or test. The program will not fund production or implementation of kits, nor will it fund studies. Eligibility for the program requires a validated economic analysis.
    - The Reliability Improvement program is a continuous process to look for opportunities to decrease demand, improve operations, and improve reliability. Projects must provide immediate help to the soldier and must show an ROI. This program will not fund production and studies.
    - The Obsolescence program is designed to mitigate obsolescence; improve reliability, maintainability, and supportability; or reduce the life-cycle cost of secondary items. Projects must provide an ROI. This program will not fund production, implementation of kits, and studies.
    - The Product Improvement Pilot program provides funding for product improvements such as improving reliability and maintainability, extending useful life, enhancing safety, and lowering maintenance costs. This program cannot be used to significantly change the performance envelope of an end item, and individual component costs may not exceed $1 million.
- *Aviation Component Improvement Program (AvCIP).* AvCIP applies to the Navy and Air Force. Within the Naval Air Systems Command (NAVAIR), AvCIP deals with common and unique avionics on in-production and fielded systems. It can fund nonrecurring engineering

[72] For more information, an organization should contact its own Air Force WCF manager.

[73] For more information, an organization should contact its Naval Supply Systems Command LECP manager.

[74] For more information, an organization should contact its manager for each of the programs.

activities such as redesign or modification, prototype development, test and evaluation, integration, and technical documentation in partnership with the Naval Supply Systems Command for reparable items and DLA for consumable items. To qualify for funding, a project must address a critical near-term issue concerning reliability, maintainability, or DMSMS; must result in cost avoidance; and must achieve significant gains in warfighting capability or readiness.[75] (No evidence exists to indicate that AvCIP will be used by the Air Force for a DMSMS issue.)

7.2. Implementation Considerations

Upon acceptance and funding, the case enters the implementation phase. The implementation phase should follow the program's standard process for updating configurations and engineering modifications. Some changes may be largely clerical and not require a specified process for updates, while other changes will require a formal change process. For instance, most updates that affect major configuration changes or engineering modifications flow through the appropriate level of the ECP process. The standard ECP process ensures that all changes and qualifications satisfy the program's requirements.

It is usually a mistake for the DMT to assume that the program's standard processes will be problem free. As a best practice, the DMT should be involved in the following ways during implementation:

- Ensure all stakeholders understand their roles and responsibilities for implementation. These roles and responsibilities should have been established when the DMT was formed.
- Ensure the implementation steps are defined.
- Verify that appropriate technical actions (for example, qualification of the new part or procurement of the part) were successfully carried out.
- Monitor the process.
- Obtain feedback on the project status to ensure maintenance of full operational availability during implementation. If the project is behind schedule, the DMT may be required to determine supplemental mitigation actions.
- Update BOMs being monitored to reflect the configuration changes once the project is completed.

In some cases, the DMT may have difficulty performing these functions. A champion in the program office is critical to implementation success. The champion should be at a high enough level to demand attention and knowledgeable in the importance of an obsolescence program to take ownership of it and justify it to program leaders. The champion is often the catalyst that brings all the functional disciplines together toward the common goal of managing the availability of the program and is the person to resolve difficulties faced by the DMT in carrying out its DMSMS management responsibilities.

[75] For more information, contact the NAVAIR AvCIP program manager.

In some cases, the DMT is asked for advice on procedures to deal with issues that arise during implementation. Below are examples of some issues, along with some considerations about ways to resolve them:

- *Improving the priority of DMSMS management with the contracting officer.* The DMT should invite the contracting officer to its meetings and explain his or her roles and responsibilities. The DMT should ensure the contracting officer understands what is needed and the associated urgency.
- *Buying in advance of need.* According to 31 U.S.C §1502 (a), the balance of an appropriation or fund, limited for obligation to a definite period, is available only for payment of expenses properly incurred during the period of availability or to complete contracts properly made within that period of availability and obligated consistent with §1501 of this title. The appropriation of funds is not available for expenditure for a period beyond the period otherwise authorized by law. A "bona fide need" statement must be documented for the General Counsel's office. That statement should explain the DMSMS situation and describe how and why the resolution option was determined. Limitation on the acquisition of excess supplies, 10 U.S.C. §2213, may also be an issue. That section of public law also provides the basis for exceptions to the limitation.
- *Procuring sufficient stock to end of need.* This is a straightforward calculation involving operating tempo, number of units in service, and failure rates (either actual or predicted). At issue is the uncertainty in the input.
- *Determining the appropriate contract vehicle.* A contract must be in place with the organization that will implement the resolution (for example, the organization performing the nonrecurring engineering, or the organization that will sell the parts). Restrictions exist on the use of all appropriations. In some cases, additional procurement funds are necessary; in others, research, development, test, and evaluation funding is required for redesign, material substitution, or qualification of a new source. The contracting office can provide advice on this subject.
- *Managing inventory.* Some issues are associated with receiving, inspecting, and storing parts. The program should plan to follow the official rules on this subject. If these problems cannot be solved, the resolution option may not be viable.

Appendix A. Developing DMSMS Workforce Competencies

This appendix outlines the recommended training required to achieve entry-level, technician-level, and leadership-level competencies and experience associated with the roles and responsibilities of DMSMS practitioners.

Entry-level training provides an individual with basic knowledge of the processes and procedures required to establish and maintain a robust DMSMS management program. An individual with entry-level competency is not expected to be proficient in analyzing DMSMS issues or leading a DMSMS management program. An individual with entry-level competency should perform DMSMS analysis only in conjunction with an individual possessing technician-level or leadership-level competency. An individual with leadership-level competency should review all data before they are submitted for approval. An individual with entry-level competency should assist with DMSMS management functions under the supervision of an individual with leadership-level competency.

An individual with technician-level competency is capable of leading, conducting, explaining, and defending the results of any analyses that he or she has led. DMSMS analysts with technician-level competency should submit analyses to a person with a DMSMS leadership-level competency for approval. A DMSMS analyst with a technician-level competency should be capable of establishing and maintaining a robust DMSMS management program with minimal oversight.

An individual with leadership-level competency is well versed, trained, and experienced in DMSMS analyses, applications, and management practices. This is the desired level for DMT leaders. A leadership-level analyst will have developed and led numerous DMSMS efforts and must be conversant in all aspects of DMSMS processes and policy. The leadership-level analyst is ultimately responsible for planning the overall DMSMS effort for a program.

DMSMS competency is not developed in a vacuum. It must be obtained in conjunction with DAU Defense Acquisition Workforce Improvement Act (DAWIA) certifications for government employees and a company analog for industry.[76]

To achieve DMSMS entry-level competency, an individual should have the following training beyond DAWIA level 1 certification:

- DAU DMSMS Fundamentals (CLL 201)
- DAU DMSMS for Executives (CLL 202)
- DAU DLA DMSMS Essentials (CLL 203)
- DAU DMSMS Case Studies (CLL 204)
- DAU DMSMS for the Technical Professional (CLL 205)
- DAU Defense Logistics Agency Support to the PM (CLL 002)
- DAU Market Research (CLC 004)
- DAU Market Research for Technical Personnel (CLE 028)

[76] DAWIA was initially enacted by Public Law 101-510 in November 1990. Most of the act is codified in 10 U.S.C. § 1701–1764.

- DAU COTS Acquisition for Program Managers (CLM 025)
- DAU Preventing Counterfeit Parts from Entering the DoD Supply System (CLL 032)
- DAU Introduction to Reducing Total Ownership Costs (CLM 021)
- DAU Fundamentals of Systems Engineering (SYS 101).

To achieve DMSMS technician-level competency, an individual should have the following training beyond DAWIA level 2 certification:

- All entry-level competency requirements
- DAU Business Case Analysis (CLL 015)
- DAU Technology Refresh Planning (CLL 019)
- DAU Independent Logistics Assessments (CLL 020)
- DAU Reliability and Maintainability (CLE 301)
- DAU Contracting for the Rest of Us (CLC 011)
- DAU Introduction to Parts Management (CLL 206)
- DAU Improved Statement of Work (CLM 031)
- DAU Technical Reviews (CLE 003)
- DAU Modular Open Systems Approach to DoD Acquisition (CLE 013)
- DAU Risk Management (CLM 017)
- DAU Acquisition Fundamentals (ACQ 101)
- DAU Performance Based Logistics (LOG 235)
- AU Lead-free Electronics Impact on DoD Programs (CLL 007).

To achieve DMSMS leadership-level competency, an individual should have the following training beyond DAWIA level 3 certification:

- All technician-level competency requirements
- DAU Configuration Management (LOG 204)
- DAU Reliability Centered Maintenance (CLL 030)
- DAU Intermediate Systems Planning, Research, Development and Engineering (SYS 202).

Table 7 lists the courses, beyond DAU certifications, needed to achieve DMSMS competency. All of the courses identified are self-paced, computer-based training and accessible via the DAU Virtual Campus link (https://learn.dau.mil). Some of the above courses are core requirements for DAWIA certifications. The table shows the DMSMS competency courses needed beyond core requirements for life-cycle logistics (LCL); systems planning, research, development, and engineering (SPRDE)–program systems engineering (PSE); SPRDE–science and technology management (STM); SPRDE–SE; production, quality, and manufacturing (PQM); program management (PM); and test and evaluation (T&E) DAWIA certifications.

Table 7. Courses Beyond DAU Certifications Needed to Achieve DMSMS Competency

Course		LCL	SPRDE-PSE	SPRDE-STM	SPRDE-SE	PQM	PM	T&E
DMSMS Entry Level								
CLC	004	X	X	X	X	X	X	X
CLE	028	X	X	X	X	X	X	X
CLL	201	X	X	X	X	X	X	X
CLL	202	X	X	X	X	X	X	X
CLL	203	X	X	X	X	X	X	X
CLL	204	X	X	X	X	X	X	X
CLL	205	X	X	X	X	X	X	X
CLL	002	X	X	X	X	X	X	X
CLL	032	X	X	X	X	X	X	X
CLM	025	X	X	X	X	X	X	X
CLM	021	X	X	X	X	X	X	X
SYS	101	Lvl 1 Core	Lvl 1 Core	Lvl 1 Core	Lvl 1 Core	X	Lvl 1 Core	Lvl 1 Core
DMSMS Technician Level								
ACQ	101	Lvl 1 Core	Lvl 1 Core	Lvl 1 Core	Lvl 1 Core	Lvl 1 Core	Lvl 1 Core	Lvl 1 Core
CLC	011	X	X	X	X	X	X	X
CLE	301	X	X	X	X	X	X	X
CLE	003	X	Lvl 2 Core	X	Lvl 2 Core	Lvl 2 Core	X	X
CLE	013	X	X	X	X	X	X	X
CLL	015	X	X	X	X	X	X	X
CLL	019	X	X	X	X	X	X	X
CLL	020	X	X	X	X	X	X	X
CLL	206	X	X	X	X	X	X	X
CLL	007	X	X	X	X	X	X	X
CLM	031	X	X	X	X	X	X	X
CLM	017	X	X	X	X	Lvl 1 Core	X	X
LOG	235	Lvl 2 Core	X	X	X	X	X	X
DMSMS Leadership Level								
LOG	204	Lvl 3 Core	X	X	X	X	X	X
CLL	030	X	X	X	X	X	X	X
SYS	202	X	Lvl 2 Core	X	Lvl 2 Core	X	Lvl 3 Core	Lvl 2 Core

Notes: LCL = life-cycle logistics; PM = program management; PQM = production, quality, and manufacturing; PSE = program systems engineering; SE = systems engineering; SPRDE = systems planning, research, development, and engineering; STM = science and technology management; and T&E = test and evaluation.

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Appendix B. Contracting

DMSMS management can be performed (1) by a program using government personnel (and SE technical assistance support), (2) by the prime contractor and its subcontractors,[77] or (3) by independent contractors.[78] The entity managing DMSMS issues for a program has no bearing on the robustness of that effort.

Regardless of who performs DMSMS management, the government remains responsible for ensuring that DMSMS risk is effectively managed. This is accomplished through the DMP, which emphasizes how a robust DMSMS management effort will reduce future obsolescence-related costs and minimize detrimental impacts on materiel readiness, operational mission capability, and safety of personnel. The DMP identifies all of the program's DMSMS planning objectives, the approach to be pursued, and the entities that will perform the functions necessary to pursue the approach (Section 3). If contractors perform the work, the DMP should describe the nature and extent of government oversight.

When a program decides to use a prime contractor (and its subcontractors) or an independent contractor for DMSMS management, contracts containing DMSMS-related requirements (including government access to sufficient DMSMS-related information), combined with government oversight, provide the basis for ensuring that DMSMS management is effective. This appendix focuses on factors and examples a program should consider incorporating into contracts with a prime contractor (and its subcontractors) or an independent contractor provider of DMSMS management.

B.1. Determining Whether to Contract for DMSMS Management

B.1.1. General Factors to Consider

Early in a program's life cycle, a decision should be made regarding who will have primary responsibility to perform DMSMS management in support of the program. This subsection includes a number of factors a program should consider in determining whether to keep DMSMS management solely within the government or to contract with a prime contractor (and its subcontractors) or an independent contractor.

B.1.1.1. Availability of Resources

Using a contractor (whether a prime contractor and its subcontractors or an independent contractor) for DSMSMS management requires funding. In some instances, the program office may already have funding available associated with a design, production, or sustainment contract. In those cases, such contracts and funding could be used to support a prime contractor and its subcontractors as the DMSMS management provider for the program. Using an independent contractor for DMSMS management normally requires a vehicle that is not with the prime contractor. There may or may not be an existing contract that can be leveraged for this purpose.

[77] The OEM should be responsible for flowing down DMSMS-related contractual requirements to its suppliers and to require those suppliers to flow down DMSMS-related requirements through their supply chains in a similar way. This appendix assumes that is the case whenever the OEM is discussed as a potential provider of DMSMS management functions.

[78] An independent contractor could be part of a government DMSMS SME team, as discussed in Section 3.

If funding available for such contracts is limited, internal government resources can usually be obtained to perform DMSMS management internal to the program.

B.1.1.2. A Contractor's DMSMS Management Capability

If a program is considering the use of a prime contractor (and its subcontractors) to provide DMSMS management, a key initial consideration is the DMSMS management capability of that contractor. If the contractor has a robust DMSMS management program in place, then the program might want to leverage that existing capability, rather than establish an entirely duplicative government-run DMSMS management program. In this case, the government might want the prime contractor to manage and mitigate DMSMS issues for the program, while the program establishes a way for the government to oversee the prime contractor's DMSMS management efforts. On the other hand, if a prime contractor's internal DMSMS management program does not appear to be sufficiently effective, then the government may need to establish its own more robust DMSMS management program.

If a program is considering the use of an independent contractor, it should consider the additional capabilities such an independent contractor might offer, as compared to other DMSMS management providers. Below are some questions that a program should consider:

- Is the independent contractor offering DMSMS management capability that is not available through the prime contractor or the government?
- What kind of capability and access does the independent contractor have regarding the receipt of PDNs or the ability to manually research parts?
- Is an independent contractor needed if the prime contractor and its subcontractors have an existing, robust DMSMS management capability?
- Have other programs used this independent contractor? How have these other programs evaluated the independent contractor's performance?

B.1.1.3. Acquisition Phase

During the design and production phases, the program already has a prime contractor under contract to develop and manufacture the system. DMSMS management and mitigation should inherently be a part of those efforts; therefore, the prime contractor and its subcontractors are in a natural position to perform these activities. In such a case, the government should ensure that a contractual requirement exists for the prime contractor to develop a DMP establishing the DMSMS management objectives and approach for the program. There is, however, the potential for conflicting forces to be at work, if DMSMS management responsibility is assigned to the prime contractor. The business objectives of any for-profit company include lowering costs and increasing revenue, whereas implementing DMSMS management practices requires expending time and resources. The contractor's leaders must believe that DMSMS management is a good business practice, because it makes products more attractive to buyers through the reduction of total ownership cost. Consequently, the contractor's products will have a competitive advantage.

Effective DMSMS management in the design phase is critical. If obsolescence is "designed in," then the program will face large costs to mitigate these problems later in the life cycle. The prime contractor and its subcontractors are in a good position to manage DMSMS issues during design, because of their familiarity with the current configuration of the design (including the potential

for rapidly changing parts). The government must remain in a position to carefully oversee what the prime contractor and its subcontractors do with regard to DMSMS management, including the identification and resolution of current and near-term obsolescence issues. Simply receiving a parts obsolescence report at a design review is not sufficient oversight; the government should have a thorough understanding of and maintain visibility into the DMSMS management processes being used by the prime contractor and its subcontractors.

Although the system's parts lists and BOMs should be stable by the time the program has entered the production phase, the government will still have limited experience with the system. Consequently, the prime contractor may continue to play a key role in DMSMS management. One of the areas that the government should include in its oversight is laying the appropriate groundwork to transition DMSMS management to the entity most appropriate to perform that role during sustainment.

Typically, the government uses a combination of three different sustainment strategies:

- In-house support through a service depot/supply system or DLA
- Non-PBL contractor support services
- PBL contracts.

In the first case, the government will typically not use the prime contractor and its subcontractors for DMSMS management. Either the government will use its own in-house capability or combine its in-house capability with an independent third-party contractor. The use of non-PBL contract support depends on the scope of work. For example, a contractor operating a repair depot on either a cost-reimbursable or fixed-price basis could be asked to perform DMSMS management. If the work is more limited (e.g., interim or emergency support), then DMSMS management could be out of scope for that contract.

PBL is a sustainment strategy that places primary emphasis on optimizing system support to meet the needs of the warfighter. PBL specifies outcome performance goals of systems, ensures that responsibilities are assigned, provides incentives for attaining those goals, and facilitates the overall life-cycle management of system reliability, supportability, and total ownership costs. It is an integrated acquisition and logistics process for buying system capability. Generally, PBL contracts are long term (5–10 years) and require that the provider manage many aspects of product support throughout the life cycle. A properly structured PBL contract contains DMSMS management requirements.

In a theoretical sense, PBL incentivizes the provider to maintain a proactive DMSMS management program to achieve the required performance outcomes. This is not always true in practice. The contractor will take the most cost-effective approach to meeting its performance requirements within the terms and conditions of its contract. This approach may not be the most cost-effective for the government when the contract is completed.

B.1.1.4. Conflicts of Interest

Whenever the government contracts for services, it must determine whether any potential conflicts of interest exist and then manage those situations effectively. For example, there could be a situation in which a nongovernment DMSMS management provider has a business interest (e.g., potential additional revenue) regarding a specific resolution option, as compared to other options. This situation does not necessarily preclude the use of that DMSMS management provider; how-

ever, it does place an additional burden on the government to appropriately oversee and understand the potential repercussions of decisions and to factor them into the program's decision-making process.

B.1.2. Considerations by Function

Below are some contracting considerations for selected activities associated with the DMSMS management steps:

- *Prepare—DMSMS infrastructure*.
  - *Define obsolescence.* The government should determine what constitutes obsolescence for the program, and any contractor responsible for DMSMS management activities should agree to this definition. For example, for the purposes of a contract, hardware, software, and firmware could be considered obsolete when the item can no longer be procured from the prime contractor, as identified in the current TDP or product specification.
  - *Develop a DMSMS management plan.* Every organization (government and contractor) conducting DMSMS management should have its own DMP. Contractors should be required to use TechAmerica Standard, GEIA-STD-0016, "Standard for Preparing a DMSMS Management Plan."
  - *Continually track and manage DMSMS cases.* This process may be performed by any combination of the three categories of providers: the government, the prime contractor and its subcontractors, or an independent contractor. Regardless of the DMSMS management provider, the government should ensure that it maintains complete records.
  - *Report performance and track cost metrics.* This may be performed by any combination of the three categories of providers: the government, the prime contractor and its subcontractors, or an independent contractor. The government should define the format to be used. Regardless of the DMSMS management provider, the government should ensure that it maintains complete records.
  - *Manage subcontractor's DMSMS management programs.* This is a required DMSMS management function for the prime contractor. Overseeing the prime contractor's management of its subcontractors' DMSMS management programs is also a government responsibility. This applies whenever DMSMS management is conducted by the prime contractor and its subcontractors.
- *Identify—DMSMS monitoring and surveillance.*
  - *Deliver parts data.* The prime contractor and subcontractors should develop, maintain, and deliver parts data to enable the identification, forecasting, and management of obsolescence issues and mitigation. Parts data include both indentured and flat BOMs or preferred parts lists for all specified subsystems down to the assembly level, depending on what is available given the current stage in the life cycle. The program must receive this data in order for a robust DMSMS management program to be successful.
  - *Continually monitor BOMs.* This process may be done by any combination of the three categories of providers: the government, the prime contractor and its subcontractors, or an independent contractor. Regardless of the DMSMS management provider, the government should ensure that it maintains complete records and that there is regular feed-

back and visibility to the program office. When this process is performed by the prime contractor and its subcontractors, there should be a process to identify and notify the government of pending and emergent obsolescence issues, supplier recall notices, and emergent vendor-implemented changes associated with the system baseline. The prime contractor should include a process for similarly notifying subcontractors.

- *Assess—impact assessment.* The key activity in this step is to continually assess DMSMS impacts. This may be done by any combination of the three categories of providers: the government, the prime contractor and its subcontractors, or an independent contractor. This applies both at the item level and at higher levels of assembly. Regardless of the DMSMS management provider, the government should ensure that it maintains complete records. Government contributions concerning programmatic and logistics factors are necessary.
- *Analyze and implement—resolution determination and implementation.* The key activity in this step is to identify cost-effective solutions. This may be done by any combination of the three categories of providers: the government, the prime contractor and its subcontractors, or an independent contractor. Regardless of the DMSMS management provider, the government should ensure that it maintains complete records. Government contributions concerning programmatic and logistics data, cost factors, and technology road maps are necessary.

B.1.3. Exit Clauses

Exit clauses for DMSMS management are a critical element in any contract, including PBL contracts. The primary purpose of this type of clause is to mitigate the risk of DMSMS issues at the end of the contract period of performance. The exit clause requires the contractor to ensure all known and forecasted DMSMS issues have been identified and have mitigation plans, so that the program office is not left with a system that is not supportable or sustainable due to DMSMS issues. It ensures that the information needed to manage DMSMS issues is provided to the program office. Exit clauses establish procedures and time frames to ensure the orderly and efficient transfer of performance responsibility upon completion or termination of the contract. The exit clauses should require delivery of those items, identified in the statement of work (SOW) or statement of objectives (SOO), within the negotiated contract price.

Exit clauses are necessary but not sufficient to guarantee the transition of DMSMS management responsibilities from one provider to another. As part of its contractor oversight, DoD should develop an understanding of all DMSMS management activities being performed by the contractor. In that way, DoD will be in the best position to ensure that effective DMSMS management continues throughout a transition.

B.2. DMSMS Management Activities in Contracts by Life-Cycle Phase

When contracting for DMSMS management, a program should develop a contract that clearly conveys DMSMS management requirements. (The program also should state, in its request for proposals and other communications, that DMSMS-related criteria will be used in source selection.) This ensures that the contractor knows its specific responsibilities for DMSMS and that the government has access to the information it needs for adequate oversight. The following is a list of representative DMSMS management activities, by acquisition phase, that a program should consider when developing contracts to cover DMSMS management:

- *Design*
    - The prime contractor and its subcontractors should minimize obsolescence throughout the contract period of performance by selecting products that will avoid or resolve hardware, software, and firmware obsolescence issues. This may be pursued through various DMSMS design considerations, such as selecting technologies or parts that are not near their end of life, parts management, open systems design, and so on, as described in Section 2.
    - The prime contractor and its subcontractors should determine the most cost-effective resolution to obsolescence issues. For the purposes of the contract, hardware, software, and firmware should be considered obsolete when the item can no longer be procured from the OCM as identified in the current TDP.
    - The prime contractor and its subcontractors should flow down DMSMS management requirements to their suppliers, who should flow down requirements in a similar manner.
    - The prime contractor should deliver a parts list and indentured BOM (or notional versions, if that is all that is available at the time), in accordance with DI-SESS-81656, to the program office at agreed upon points in the technical schedule.
    - The prime contractor and its subcontractors (and possibly an independent third-party contractor if one is to be used) should monitor the availability of parts and components (with agreed-upon frequency of update) and provide the results to the program office. The government should be notified of pending and emergent obsolescence issues, supplier recall notices, and emergent vendor-implemented changes.
    - The prime contractor and its subcontractors should resolve and document any DMSMS issues prior to delivery of design. (Supplemental funding for the contractor may be necessary.)
    - The prime contractor should deliver a production road map for low rate initial production.
    - The prime contractor should deliver a supportability road map (with agreed-upon frequency of updates).
    - The prime contractor should deliver a description of how the system is envisioned to be supported after fielding, including the process for assigning the source of repair.
    - The prime contractor and its subcontractors (and possibly an independent third-party contractor if one is to be used) should participate in the government-contractor obsolescence working group (with frequency of face-to-face and telephone communications specified).

- *Production*
    - The prime contractor and its subcontractors should minimize obsolescence throughout the contract period of performance by selecting suppliers that will avoid or resolve hardware, software, and firmware obsolescence issues.
    - The prime contractor and its subcontractors should determine the most cost-effective resolution to obsolescence issues. For the purposes of the contract, hardware, software, and firmware should be considered obsolete when the item can no longer be procured from the OCM as identified in the current TDP.
    - The prime contractor and its subcontractors should flow down DMSMS management requirements to their suppliers, who should flow down requirements in a similar manner.
    - The prime contractor should deliver a parts list and indentured BOM, in accordance with DI-SESS-81656, to the program office if it has not already been delivered.
    - The prime contractor and its subcontractors (and possibly an independent third-party contractor if one is to be used) should monitor the availability of parts and components (with agreed-upon frequency of update) and provide the results to the program office. The government should be notified of pending and emergent obsolescence issues, supplier recall notices, and emergent vendor-implemented changes.
    - The prime contractor and its subcontractors should solve and document any DMSMS issues prior to delivery of the system for fielding.
    - The prime contractor and its subcontractors (and possibly an independent third-party contractor if one is to be used) should participate in the government-contractor obsolescence working group (with frequency of face-to-face and telephone communications specified).
    - The prime contractor and its subcontractors should develop and execute a plan to transition DMSMS management to the sustainment provider.
- *Sustainment*
    - The sustainment provider should minimize obsolescence throughout the contract period of performance by selecting suppliers that will avoid or resolve hardware, software, and firmware obsolescence issues.
    - The sustainment provider, especially in the PBL case, should determine the most cost-effective resolution to obsolescence issues. For the purposes of the contract, hardware, software, and firmware should be considered obsolete when the item can no longer be procured from the OCM as identified in the current TDP.
    - The sustainment provider, especially in the PBL case, should flow down DMSMS management requirements to suppliers, who should flow down requirements in a similar fashion.
    - The sustainment provider (and possibly an independent third-party contractor if one is to be used) should monitor the availability of parts and components (with agreed-upon frequency of update) and provide the results to the program office. The government should be notified of pending and emergent obsolescence issues, supplier recall notices, and emergent vendor-implemented changes.

- o The sustainment provider (and possibly an independent third-party contractor if one is to be used) should participate in the government-contractor obsolescence working group (with frequency of face-to-face and telephone communication specified).
- o The sustainment provider should recommend DMSMS resolutions.

B.3. Examples of DMSMS Management Contract Language

This section contains several examples of how DMSMS management responsibilities have been documented in contract language:

- Example 1 contains contract language about the DMSMS management plan.
- Example 2 contains DMSMS resolution-related contract language.
- Example 3 contains SOW/SOO language on BOM, configuration management, and DMSMS issue forecasting and notifications-related requirements.
- Example 4 contains language detailing intent to use DMSMS management factors in review of approaches.
- Example 5 contains contract language related to the assignment of DMSMS management responsibilities support for design/production.
- Example 6 contains language pertaining to the assignment of DMSMS management responsibilities support for production.
- Examples 7–11 contain contract language detailing the assignment, to a contractor, of either generic responsibility for obsolescence management or the responsibility for multiple DMSMS-related activities.
- Example 12 contains contract language detailing the assignment, to a contractor, of responsibility for obsolescence management during production.
- Example 13 shows language that a prime contractor or a subcontractor could use to flow down DMSMS requirements to a supplier.

The DMSMS management program should ensure that the chosen contract language clearly specifies the DMSMS management responsibilities being assigned to the contractor and enables the government access to the information it needs to maintain effective DMSMS management oversight. The examples should be tailored to the specific situation. In addition to the examples here, the Navy has developed example CDRLs for an AoA, BOM, DMP, and a report. They are designed to assist programs with developing their own deliverables. These CDRLs can be found on the DKSP.

Example 1. DMSMS Management Plan

The Contractor shall develop and submit as part of its proposal (with an advance copy supplied to the Government at time of cost estimate submission), an Obsolescence and DMSMS Management Plan for managing the loss, or impending loss, of manufacturers or suppliers of parts and/or material required for performance of this contract. At a minimum, the plan shall address the following:

- Means and approach for providing the Government with information regarding obsolescence and DMSMS issues

- Planned resolution of current obsolescence and DMSMS issues
- Parts list screening
- Parts list monitoring
- Receiving, processing and disseminating Government-Industry Data Exchange Program (GIDEP) DMSMS Notices
- Receiving, processing and disseminating Defense Logistics Agency (DLA) DMSMS Alerts
- Communication with and availability of information to the Government
- Means and approach for establishing obsolescence and DMSMS solutions
- Plan for conducting DMSMS predictions.

Example 2. DMSMS Resolution-Related Contract Language

Company X is responsible to provide support for all valid requirements including those instances where DMS/MS and obsolete piece part issues impact, delay, or prohibit the acquisition of necessary piece parts except as discussed below. Where DMS/MS solutions have been funded under Program Office funding and separate contract, Company X is responsible to monitor, identify and plan the resolution of DMS/MS and parts obsolescence issues and should plan far enough in advance to alleviate DMS/MS and parts obsolescence occurrences. Company X may propose and submit DMS/MS resolution plans to the … Program Office and [Service inventory control point program manager] which include Life-of-Type buys and Bridge buys, proposed to meet the requirements of each delivery order and what is suggested for any post-contractual period. Although Company X is authorized to use existing Government DMS/MS resolution efforts, Company X nonetheless retains full responsibility for resolving DMS/MS issues. ...

b. Company X shall inform the Government of known or suspected DMS/MS issues for resolution upon discovery. Company X shall include all known information related to the DMS/MS issues at the time of Government notification. DMS/MS does not excuse Company X from the performance of metrics identified in Section H. In the event the program office… funding for DMS/MS effort is not adequate or not provided in a timely manner, the [Service inventory control point] Contracting Officer may, in his or her discretion, provide relief from Company X’s responsibility for fulfillment of performance metrics for resolutions. Company X shall submit all DMS/MS resolution recommendations to the Contracting Officer and Program Office or designated agent for final disposition. Upon a final DMS/MS resolution decision by the Government, Company X shall provide support for Life of Type, or Bridge Buy storage as required to implement the DMS/MS resolution.

Example 3. SOW/SOO Example of BOM, Configuration Management, and DMSMS Issue Forecasting and Notifications-Related Requirements

1.0 Bill of Materials (BOM)
   - 1.1 Periodic delivery of updated BOMs to the PO in an indentured format (in accordance with DID DI-SESS-81656)
   - 1.2 Mitigation process of obtaining source data to forecast DMSMS if prime vendor or supplier will not provide a BOM

1.3 The contractor shall identify, as applicable, the parts planned to be used, as well as those used in the product at all indentured levels. The data may be obtained progressively during any program life cycle phase using sources such as the preferred parts list, build-of-materials, vendor surveys, inspections, etc. The information documented at the part level shall be updated as the design progresses or changes and be sufficient to enable forecasting and management of any associated DMSMS issues.

2.0 Configuration Management/Control

2.1 Validation of the system's technical data to ensure all configuration changes are incorporated into the Configuration Management (CM) data base and drawings to ensure the system's most current configuration is documented

2.2 CM of DMSMS addressed in the CM program plan

3.0 DMSMS Forecasting and Notifications

3.1 Use of predictive tools/methods to proactively forecast and monitor parts for DMSMS and provide results to PO, access/insight into tools, DMSMS status at all reviews.

Example 4. Language Detailing Intent to Use DMSMS Management Factors in Review of Approaches

Proposals will be evaluated on the management approach and the adequacy of planning for mitigating DMSMS risks. Proposals including management plans defining a proactive approach to manage DMSMS will receive more favorable ratings than those without such an approach. A proactive approach will include predictive forecasting strategies, parts list screening to the piece part level, parts list monitoring, matching of parts to the weapons systems' environment across the vendor chain, methodologies for tracking, reporting, and mitigating DMSMS cases to avoid costly solutions, and a process to manage sub tier suppliers' DMSMS efforts.

Example 5. Assignment of DMSMS Management Responsibilities Support for Design/Production

3.4.12.7.1.3 Diminishing Manufacturing Sources and Material Shortages (DMSMS) When addressing DMSMS and obsolescence in the XXX Parts Management Plan, the contractor shall include the following:

- Means and approach for providing the Government with information regarding obsolescence and DMSMS issues
- Planned resolution of current obsolescence and DMSMS issues
- Parts list screening
- Parts list monitoring
- Receiving, processing and disseminating GIDEP DMSMS Notices
- Receiving, processing and disseminating DLA DMSMS Alerts
- Communication with and availability of information to the Government
- Means and approach for establishing obsolescence and DMSMS solutions
- Plan for conducting DMSMS predictions.

Example 6. Assignment of DMSMS Management Responsibilities Support for Production

The Contractor/sub-contractor shall be an integral part and maintain full participation with the Program Office Obsolescence DMSMS IPT as follows:

Formal notification to alerts (Government Industry Data Exchange Program (GIDEP), Predictive Tool, as utilized by the Contractor) shall be submitted quarterly via the XXXX when they affect the YYY Program through this effort. The Contractor shall notify the XXX DMSMS IPT upon discovery of immediate or imminent DMSMS issues impacting the ability to manufacture articles under this SOW. The Contractor shall participate in quarterly DMSMS working groups to assist XXX in determining the best course of action to address these DMSMS issues. The Contractor shall notify XXX immediately should it be unable to maintain the capability to manufacture, repair and yield rates for articles under this SOW. The Contractor shall update and supply an indentured Bill of Materials (BOM) list quarterly via the CITIS. The Contractor shall analyze the YYY configurations and identify those items that are critical to supporting the YYY system. Potential DMSMS problems include, but are not limited to:

(a) Remanufacture issues, either performed organically by XXX or another Contractor's facility.

(b) Closing of production lines due to Contractor downsizing, streamlining, contract termination or production line closeout

(c) Identification of impact assessment of diminishing sources of supply, to include parts obsolescence issues.

(d) Expected/unexpected discontinuances of business (terminal closure) by the Contractor.

(e) Re-procurement/repair of Commercial Off the Shelf (COTS) items.

The Contractor shall determine if any of these potential problems can or will exist during the production contract and make recommendations for resolving them.

Example 7. Assignment of Obsolescence Management Responsibility to the Contractor

The Contractor is responsible for managing obsolescence over the entire period of the contract, and notwithstanding any obsolescence issues or problems, the Contractor remains responsible for meeting all performance and other requirements of this contract. This obsolescence management responsibility includes an ongoing review and identification of actual and potential obsolescence issues, including but not limited to obsolescence of components, assemblies, sub-assemblies, piece parts, and material (hereafter referred to for purposes of this section only as "parts and/or material"). The Contractor is responsible for all costs associated with obtaining a replacement if and when any parts and/or material become obsolete. The costs for which the Contractor is responsible include, but are not limited to, the costs of investigating part availability, interchangeability and substitutability, locating part replacement, vendor interface, engineering efforts, testing requirements, internal drawing changes, etc. The Contractor shall prevent any additional costs from being incurred by the Government due to obsolescence. Any configuration changes due to obsolescence shall be approved in accordance with the Configuration Management requirements of this SOW. The Contractor shall provide the Government with obsolescence status briefs, as part of the periodic program reviews provided for under the contract.

Example 8. Assignment of Obsolescence Management Responsibility to the Contractor

The Contractor is responsible for managing obsolescence over the entire period of the contract to ensure compliance with all performance and contract requirements. Responsibility includes all costs associated with locating part replacement, vendor interface, and engineering efforts. The Contractor shall develop a plan for managing the loss, or impending loss, of manufacturers or suppliers of components, assemblies, or materials used in the system. Changes considered necessary by the Contractor to ensure the continued manufacture and/or repair of the equipment shall be made in accordance with the Configuration Management requirements of this SOW. The Contractor's Obsolescence Management Plan shall include language identifying their participation in the Government-Industry Data Exchange Program (GIDEP). The Contractor will not be responsible for redesign cost for obsolescence initiatives producing Class I changes. System/sub-System/Component redesign efforts will be pursued only after the Contractor has researched and eliminated all other potential mitigation options.

Example 9. Assignment of Obsolescence Management Responsibility to the Contractor

The Contractor's obsolescence management program shall prevent the impact to contract performance metrics and shall prevent additional costs being incurred by the Government due to obsolescence. The Contractor is 100% responsible for all obsolescence issues/problems with regard to the items in the contract, including: managing the loss or impending loss of manufacturers or suppliers for the spare and repairable items covered under the XXXX PBL Program. The Contractor shall manage obsolescence issues/problems in order to prevent the impact to contract performance metrics. Costs related to obsolescence issues/problems will be borne by the Contractor during the life of the contract. Changes considered necessary by the Contractor to ensure the continued manufacture and/or repair of the items will be made in accordance with XXXX requirements and/or Configuration Management requirements.

Example 10. Assignment of Obsolescence Management Responsibility to the Contractor

The Contractor, on a continuous basis during contract performance, shall review and identify obsolescence issues related to piece parts for the items listed in Attachment "X." The Contractor shall be responsible for piece part acquisition of replacement items to avoid obsolescence or repair turnaround issues. Should obsolescence or DMSMS issues occur that preclude the Contractor from obtaining spares of the current design for any vendor repairable item, as identified in Attachment "X," any redesign, qualification and production efforts will be considered "over and above" this statement of work. Such issue shall relieve the Contractor from availability for that item. The Contractor will perform an engineering analysis of these items and provide recommended solutions. If in the course of an engineering review of the items in Attachment "X," the Contractor identifies other obsolescence issues concerning the end item test sets, the Contractor may notify the Government of these issues and possible remedies.

Example 11. Assignment of Obsolescence Management Responsibility to the Contractor

The Contractor is responsible for managing obsolescence over the entire period of the contract to ensure compliance with all performance and contract requirements. Responsibility includes all costs associated with locating part replacement, vendor interface, and engineering efforts. The Contractor shall develop a plan for managing the loss, or impending loss, of manufacturers or suppliers of components, assemblies, or materials used in the system. Changes considered necessary by the Contractor to ensure the continued manufacture and/or repair of the equipment shall be made in accordance with the Configuration Management requirements of this SOW. The Contractor's Obsolescence Plan shall include participation in GIDEP.

The Contractor will not be responsible for redesign cost for obsolescence initiatives producing Class I changes. Redesign effort to proceed only after the Contractor has exhausted all options to accomplish engineering efforts for drop in replacement.

The Contractor's obsolescence program shall prevent impact to contract performance metrics and shall prevent additional costs being incurred by the Government due to obsolescence.

The Contractor is 100% responsible for all obsolescence issues/problems with regard to the items in the contract, including: managing the loss or impending loss of manufacturers or suppliers for the spare and repairable items covered under the XXX PBL Program. The Contractor must manage obsolescence issues/problems in order to prevent impact to contract performance metrics. Cost related to obsolescence issues/problems will be borne by the Contractor during the life of the contract. Changes considered necessary by the Contractor to ensure the continued manufacture and/or repair of the items will be made in accordance with … requirements and/or Configuration Management requirements.

The Contractor, on a continuous basis during contract performance, shall review and identify obsolescence issues related to piece parts for the items listed in Attachment "X." The Contractor shall be responsible for piece part acquisition of replacement items to avoid obsolescence or repair turnaround issues. Should obsolescence or DMSMS issues occur that preclude the contractor from obtaining spares of the current design for any vendor repairable item, as identified in Attachment "X," any re-design, qualification and production efforts will be considered "over and above" this statement of work. Such issue shall relieve the contractor from availability for that item. The Contractor will perform an engineering analysis of these items and provide recommended solutions. If in the course of an engineering review of the items in Attachment "X," the Contractor identifies other obsolescence issues concerning the end item test sets, the contractor may notify the Government of these issues and possible remedies.

Example 12. Assignment of Obsolescence Management Responsibility to the Contractor during Production

3.1.8.11 Diminishing Manufacturing Sources and Material Shortages (DMSMS)

3.1.8.11.1 (CLIN 0009) DMS Management

XXXX shall perform integrated DMS and Technology Refreshment Planning in accordance with the XXXX DMSMS Management Plan, reference document 2.49 and the XXXX Technology Refreshment Management Plan (2YZA00019), reference document 2.50. XXXX shall proactively manage DMS to ensure viable ongoing production and analyze impacts affecting future availability or logistics support of deliverable equipment. XXXX shall perform technology refreshment planning based on DMS drivers and supply trends, to define recommended system refresh timelines based on lowest total program cost. Technology refreshment planning shall be coordinated with any capability upgrade roadmap activities accomplished by the Follow-on Development competency, to allow for an integrated program capability/tech-refresh roadmap

XXXX shall flow down DMS requirements to suppliers and sub-contractors to the extent necessary to fulfill requirements under this statement of work. XXXX shall ensure that each supplier has established and utilized an effective DMS management program that identifies DMS status for all parts, materials, assemblies, subassemblies, and software items used in the current and prior configurations of deliverable equipment.

The XXXX DMS Management activity shall include:

a) A process for identification, resolution and implementation for all DMS/obsolescence issues associated with components, materials, assemblies, subassemblies, and software items used in deliverable hardware, logistics support system, and support and training equipment under this contract. The contractor shall generate DMS case reports and recommendations based on trade study results. The reports shall be in accordance with CDRL A00M.
b) A semi-annual obsolescence status report to inform the Government and International Partners of current year's DMS/obsolescence status including near-term risks, pending DMS cases, DMS parts and materials inventory assessment, as well as upcoming redesign activities, in accordance with CDRL A00N.
c) A semi-annual, contractor-led Obsolescence Working Group (OWG) during the life of the contract. These meetings shall occur within 45 days after the submittal of the semi-annual obsolescence report (CDRL A00N). Participation planning and specific meeting objectives will be decided and agreed upon by the Government and the Contractor no later than 14 days prior to each meeting date. In general, current and predicted DMS issues that have significant impacts to production and sustainment, DMS stock positions that have become excess for disposition (e.g. the result of profile changes or redesign activities), and coordination of Follow-on Development activities will be included. The Contractor shall maintain minutes and action item assignments and resolutions from each meeting.
d) An annual 10-year rolling electronic systems DMS redesign and tech refresh plan to include both hardware and software air system elements in accordance with CDRL A00P. This plan will define the optimally recommended refresh point for air system components based on lowest total program cost, and will be provided for integration with any future upgrade roadmaps.

e) A semi-annual 5-year rolling DMS activity and cost forecast to assist in program and budget planning in accordance with CDRL A00Q. This forecast will inherently contain and be based on the integrated technology refreshment plan (CDRL A00P), and will cover known and anticipated DMS events for the 5-year period.
f) DMS modeling capability to assist in the development of cost forecasts and in ongoing DMS/tech refresh upgrade trade studies and program decisions. This modeling shall provide the capability to evaluate the impact of non-optimal tech refresh timelines and include allowances for the high variability inherent in DMS forecasting.

3.1.8.11.2 (CLIN 0004) DMS Redesigns

XXXX shall perform redesign, as authorized in this contract, to resolve Diminishing Manufacturing Sources (DMS) in accordance with Section F and CDRL A00R.

Example 13. Contractor Flow-Down to a Supplier

Subcontractors/suppliers shall monitor parts obsolescence over the period of performance. Obsolescence monitoring includes an ongoing review and identification of actual and potential obsolescence issues, including but not limited to obsolescence of components, assemblies, subassemblies, piece parts, and material. The subcontractor/supplier is responsible for identifying the obsolete components and whether or not a simple replacement of the component is required or a redesign (that will drive a change in specification, ATP, and/or form/fit/function of the delivered item. Obsolescence issues that are identified during the period shall be documented and provided to (Name of Prime) via report on a (frequency specified). In addition, the subcontractor/supplier is responsible for identifying the potential cost (NTE ROM) of addressing the obsolescence issue, as well as the time required to implement the change. The NTE ROM shall include the costs for full investigating part availability, interchangeability and substitutability; locating part replacement; vendor interface; engineering efforts; testing requirements; internal drawing changes; etc. Any changes in configuration being driven by obsolescence must be approved by (Name of Prime) IAW contract requirements.

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Appendix C. DMSMS Management Questions for Systems Engineering Technical Reviews

This appendix contains DMSMS management questions intended for use by DMSMS practitioners to prepare for six of the SE technical reviews of primary importance:

- Alternative Systems Review (ASR)
- Systems Requirements Review (SRR)
- System Functional Review (SFR)
- Preliminary Design Review (PDR)
- Critical Design Review (CDR)
- Production Readiness Review (PRR).

The questions are designed for the program office, but many also apply to prime contractors and subcontractors. The questions are presented in six tables. Tables 8–12, respectively, contain questions pertinent to the five DMSMS management steps: prepare, identify, assess, analyze, and implement. They are further broken down by process. Table 13 contains questions that apply to SE technical reviews but do not relate directly to a particular DMSMS step or process.

Table 8. DMSMS Management Questions for Systems Engineering Technical Reviews: Prepare (Chapter 3)

Process	ASR	SRR	SFR	PDR	CDR	PRR
Develop DMP	Has any DMSMS management planning been initiated? If so, is the initial DMSMS management planning focused on the most likely preferred systems concept?	Has the program started to develop its strategy and plan for addressing and managing the impact of DMSMS issues?	Has the program established a robust DMSMS management strategy and program that identifies obsolescence due to DMSMS issues before critical parts are unavailable?	Has a government DMP been formally approved by program leadership?	Is the DMSMS management program being executed per the formal approved DMP?	Is the DMSMS management program being executed per the formal approved DMP?

Table 8. DMSMS Management Questions for Systems Engineering Technical Reviews: Prepare (Chapter 3)

Process	ASR	SRR	SFR	PDR	CDR	PRR
Develop DMP (cont'd)	Are DMSMS impacts a consideration when analyzing alternative systems to help ensure that the preferred system is cost effective, affordable, operationally effective, and suitable and can be developed to provide a timely solution to a need at an acceptable level of risk?	Is language developed and included in the SOO/SOW/RFP documentation requiring the prime contractor to provide its strategy and plan to address the impact of DMSMS issues and obsolescence?	Is this reflected in a draft government DMP (DoD 4140.1-R, "DoD Supply Chain Materiel Management Regulation," May 2003)?		Is the government DMP being updated, as necessary?	Is the government DMP being updated, as necessary?
		Does the draft DMP identify the roles and responsibilities of the prime/subcontractor and third-party vendors?	Does the draft government DMP identify the roles and responsibilities of the prime/subcontractor and third-party vendors?	Does the approved government DMP identify the roles and responsibilities of the prime/subcontractor and third-party vendors?		
		Have these roles and responsibilities of the government, prime/subcontractor, and third-party vendors been established as contractual requirements?	Have these roles and responsibilities of the government, prime/subcontractor, and third-party vendors been established as contractual requirements?	Have these roles and responsibilities of the government, prime/subcontractor, and third-party vendors been established as contractual requirements?	Are the roles and responsibilities of the government, prime/subcontractor and third-party vendors being executed?	Are the roles and responsibilities of the government, prime/subcontractor and third-party vendors being executed?

Table 8. DMSMS Management Questions for Systems Engineering Technical Reviews: Prepare (Chapter 3)

Process	ASR	SRR	SFR	PDR	CDR	PRR
Develop DMP (cont'd)		Are prime contractors flowing down DMSMS management requirements to their subcontractors and are those subcontractors being required to flow down requirements to their supply chains in a similar way?	Are prime contractors flowing down DMSMS management requirements to their subcontractors and are those subcontractors being required to flow down requirements to their supply chains in a similar way?	Are prime contractors flowing down DMSMS management requirements to their subcontractors and are those subcontractors being required to flow down requirements to their supply chains in a similar way? Is a Contract Data Requirements List (CDRL) included for the delivery of the prime contractor's DMP?	Are prime contractors flowing down DMSMS management requirements to their subcontractors and are those subcontractors being required to flow down requirements to their supply chains in a similar way?	Are prime contractors flowing down DMSMS management requirements to their subcontractors and are those subcontractors being required to flow down requirements to their supply chains in a similar way?
		Are there exit strategies in the contracts that require all sustainment providers to ensure no component end-of-life issues are unresolved at the completion of the period of performance?	Are there exit strategies in the contracts that require all sustainment providers to ensure no component end-of-life issues are unresolved at the completion of the period of performance?	Are there exit strategies in the contracts that require all sustainment providers to ensure no component end-of-life issues are unresolved at the completion of the period of performance?	Are there exit strategies in the contracts that require all sustainment providers to ensure no component end-of-life issues are unresolved at the completion of the period of performance?	Are there exit strategies in the contracts that require all sustainment providers to ensure no component end-of-life issues are unresolved at the completion of the period of performance?
		Is the government conducting sufficient oversight when contractors are responsible for executing DMSMS operational processes?	Is the government conducting sufficient oversight when contractors are responsible for executing DMSMS operational processes?	Is the government conducting sufficient oversight when contractors are responsible for executing DMSMS operational processes?	Is the government conducting sufficient oversight when contractors are responsible for executing DMSMS operational processes?	Is the government conducting sufficient oversight when contractors are responsible for executing DMSMS operational processes?
Form DMT		Have DMT members been identified?	Has a partial DMT been formed?	Has a partial DMT been formed?	Has the full DMT been formed?	Has the full DMT been formed?

Table 8. DMSMS Management Questions for Systems Engineering Technical Reviews: Prepare (Chapter 3)

Process	ASR	SRR	SFR	PDR	CDR	PRR
Form DMT (cont'd)			Do all identified DMT members understand their roles and responsibilities and have adequate training to fulfill their roles and responsibilities?	Do all identified DMT members understand their roles and responsibilities and have adequate training to fulfill their roles and responsibilities?	Do all identified DMT members understand their roles and responsibilities and have adequate training to fulfill their roles and responsibilities?	Do all identified DMT members understand their roles and responsibilities and have adequate training to fulfill their roles and responsibilities?
Secure operations funding			Have current and outyear DMSMS operating budgets been estimated and identified?	Have current and outyear DMSMS operating budgets been established, approved, and funded?	Have current and outyear DMSMS operating budgets been established, approved, and funded?	Have current and outyear DMSMS operating budgets been established, approved, and funded?
Establish operational processes			Is the process of defining and documenting all DMSMS operational processes in the government DMP underway?	Have all DMSMS operational processes been defined and documented in the government DMP?		
Manage case			Has the program defined DMSMS metrics that will be captured and tracked for DMSMS cases, trends, and associated resolutions and costs?	Has the program defined DMSMS metrics that will be captured and tracked for DMSMS cases, trends, and associated resolutions and costs?	Is the program using DMSMS metrics to track DMSMS cases, trends, and associated resolutions and costs?	Is the program using DMSMS metrics to track DMSMS cases, trends, and associated resolutions and costs?
				Has the program identified how it will capture and track DMSMS metrics? Has the program developed or identified a DMSMS case tracking database?		

Table 8. DMSMS Management Questions for Systems Engineering Technical Reviews: Prepare (Chapter 3)

Process	ASR	SRR	SFR	PDR	CDR	PRR
Evaluate program			Has planning begun for reporting DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions)?	Has a plan to report DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) been established?	Has a plan to report DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) been updated?	Has a plan to report DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) been updated?
					Are DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) being reported to program management?	Are DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) being reported to program management?
Ensure quality			Has the process of establishing metrics to measure the efficiency of DMSMS operational processes begun?	Have metrics been established to measure the efficiency of DMSMS operational processes and to drive continuous process improvement?	Are process efficiency metrics being used to drive continuous process improvement of the DMSMS operational processes?	Are process efficiency metrics being used to drive continuous process improvement of the DMSMS operational processes?

Table 9. DMSMS Management Questions for Systems Engineering Technical Reviews: Identify (Chapter 4)

Process	ASR	SRR	SFR	PDR	CDR	PRR
Prioritize systems			Are mission criticality, operational safety, and DMSMS-related costs being considered to identify and prioritize the systems and subsystems to be monitored?	Are mission criticality, operational safety, and DMSMS-related costs being used to identify and prioritize the systems and subsystems to be monitored?	Are mission criticality, operational safety, and DMSMS-related costs being used to identify and prioritize the systems and subsystems to be monitored?	Are mission criticality, operational safety, and DMSMS-related cost being used to identify and prioritize the systems and subsystems to be monitored?

Table 9. DMSMS Management Questions for Systems Engineering Technical Reviews: Identify (Chapter 4)

Process	ASR	SRR	SFR	PDR	CDR	PRR
Identify and procure monitoring and surveillance tools			Have DMSMS forecasting and associated data collection and management tools or service providers been researched?	Have DMSMS forecasting and associated data collection and management tools or service providers been researched and selected?	Have DMSMS forecasting and associated data collection and management tools been reviewed to determine their continued suitability for sustainment?	Have DMSMS forecasting and associated data collection and management tools been reviewed to determine their continued suitability for sustainment?
					Have tool selections been made to supplement, as necessary?	Have tool selections been made to supplement, as necessary?
Collect and prepare parts data				Have the parts associated with critical system functions been identified? Is a CDRL included for the delivery of the system BOM?	Have the parts associated with critical system functions been updated?	Have the parts associated with critical system functions been updated?
				Have notional BOMs for the system been acquired in accordance with DI-SESS-81656?	Have indentured BOMs for the system been acquired in accordance with DI-SESS-81656?	Have indentured BOMs for the system been acquired in accordance with DI-SESS-81656?
				Does the program also have a strategy for obtaining the following: ◆ Design disclosed items, including subtier hardware indenture levels ◆ F3/proprietary design items, including subtier hardware indenture levels ◆ Items that are single source and those for which the government cannot obtain data rights and the associated corrective action plans are identified?	Has the program obtained the following: ◆ Design disclosed items, including subtier hardware indenture levels ◆ F3/proprietary design items, including subtier hardware indenture levels ◆ Items that are single source and those for which the government cannot obtain data rights and the associated corrective action plans are identified?	Has the program obtained the following: ◆ Design disclosed items, including subtier hardware indenture levels ◆ F3/proprietary design items, including subtier hardware indenture levels ◆ Items that are single source and those for which the government cannot obtain data rights and the associated corrective action plans are identified?

Table 9. DMSMS Management Questions for Systems Engineering Technical Reviews: Identify (Chapter 4)

Process	ASR	SRR	SFR	PDR	CDR	PRR
Collect and prepare parts data (cont'd)				Has the notional BOM been loaded into the selected forecasting/ management tool in order to perform an initial DMSMS parts availability assessment?	Has the build baseline/final design BOM been loaded into the selected forecasting/ management tool in order to perform a DMSMS parts availability assessment?	Has the BOM been regularly updated and reloaded into a DMSMS forecasting/management tool and/or service in order to perform periodic DMSMS parts availability assessments?
Analyze parts availability				Are the selected forecasting/ management tool or the results of manual research being used to identify immediate and near-term obsolescence issues associated with the notional BOM? For any DMSMS issues identified, are they addressed and mitigated prior to establishment of the build baseline/final design BOM?	Have the selected forecasting/ management tool or the results of manual research been used to identify immediate and near-term obsolescence issues associated with the build baseline/final design BOM? For any DMSMS issues identified, are they addressed and mitigated prior to acceptance and approval of the build baseline/final design BOM?	Are the selected forecasting/ management tool or the results of manual research being used to identify immediate and near-term obsolescence issues associated with the BOM?
					Is the program receiving obsolescence forecasts on a scheduled basis?	Is the program receiving obsolescence forecasts on a scheduled basis?
					Are product discontinuation notices being received regularly?	Are product discontinuation notices being received regularly?
Collect and update programmatic and logistics data			Have programmatic and predicted reliability data needs for impact assessment been identified?	Have programmatic and predicted reliability data needs for impact assessment been updated?	Have programmatic and predicted reliability data needs for impact assessment been updated and collected?	Have programmatic and predicted reliability data needs for impact assessment been updated and collected?

Table 10. DMSMS Management Questions for Systems Engineering Technical Reviews: Assess (Chapter 5)

Process	ASR	SRR	SFR	PDR	CDR	PRR
Assess impact			Is a formal technology road map and insertion/refreshment strategy being developed for all, or portions of, the program/system?	Has a formal technology road map and approved insertion/refreshment strategy been developed?	Has a formal technology road map and approved insertion/refreshment strategy been developed and funded?	Has a formal technology road map and approved insertion/refreshment strategy been reviewed for potential updates and adjustments?
			Does the technology road map and insertion/refreshment strategy focus on and address the identification of critical items and technologies, as well as emerging technologies?	Does the road map and insertion/ refreshment strategy identify critical items and technologies, as well as emerging technologies?	Does the technology road map and insertion/refreshment strategy identify critical items and technologies, as well as emerging technologies?	Does the technology insertion/ refreshment plan identify critical items and technologies, as well as emerging technologies?
			Is the technology insertion/refreshment plan being used to determine the time frame for potential DMSMS operational impacts?	Is the technology insertion/refreshment plan being used to determine the time frame for potential DMSMS operational impacts?	Is the technology insertion/refreshment plan being used to determine the time frame for potential DMSMS operational impacts?	Is the technology insertion/refreshment plan being used to determine the time frame for potential DMSMS operational impacts?
			Are DMSMS issues being considered as a basis for adjusting the scope or schedule of the technology insertion/refreshment?	Are DMSMS issues being considered as a basis for adjusting the scope or schedule of the technology insertion/refreshment?	Are DMSMS issues being considered as a basis for adjusting the scope or schedule of the technology insertion/refreshment?	Are DMSMS issues being considered as a basis for adjusting the scope or schedule of the technology insertion/refreshment?
			Are DMSMS operational risks being identified and prioritized?	Are DMSMS operational risks being identified and resolved?	Are DMSMS operational risks being identified and resolved?	Are DMSMS operational risks being identified and resolved?
			Is the monitoring of usage of and anticipated demand for parts being considered in DMSMS impact assessment?	Is the monitoring of usage of and anticipated demand for parts being considered in DMSMS impact assessment?	Is the monitoring of usage of and anticipated demand for parts being considered in DMSMS impact assessment?	Is the monitoring of usage of and anticipated demand for parts being considered in DMSMS impact assessment?

Table 11. DMSMS Management Questions for Systems Engineering Technical Reviews: Analyze (Chapter 6)

Process	ASR	SRR	SFR	PDR	CDR	PRR
Determine resolution				Are DMSMS impacts being identified and addressed during the initial parts availability analysis prior to acceptance and approval of the notional BOM?	Are resolutions to DMSMS impacts being identified and addressed during the parts availability analysis prior to acceptance and approval of the build baseline/final design BOM?	Are resolutions to DMSMS impacts being identified for the BOM?
				Is a BCA or AoA being performed (including ROI calculations) as part of resolution determination?	Is a BCA or AoA being performed (including ROI calculations) as part of resolution determination?	Is a BCA or AoA being performed (including ROI calculations) as part of resolution determination?
				Have all costs associated with a resolution been considered?	Have all costs associated with a resolution been considered?	Have all costs associated with a resolution been considered?
				Do mitigation strategies clearly address the entire system life cycle (not just the contract period)?	Do mitigation strategies clearly address the entire system life cycle (not just the contract period)?	Do mitigation strategies clearly address the entire system life cycle (not just the contract period)?
				Has resolution determination taken into account that the most cost-effective resolution may be found at a higher level of assembly?	Has resolution determination taken into account that the most cost-effective resolution may be found at a higher level of assembly?	Has resolution determination taken into account that the most cost-effective resolution may be found at a higher level of assembly?

Table 12. DMSMS Management Questions for Systems Engineering Technical Reviews: Implement (Chapter 7)

Process	ASR	SRR	SFR	PDR	CDR	PRR
Secure resolution			Have any DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) been identified for use in supporting funding requests?	Are DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) being used to support funding requests?	Are DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) being used to support funding requests?	Are DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) being used to support funding requests?

Table 12. DMSMS Management Questions for Systems Engineering Technical Reviews: Implement (Chapter 7)

Process	ASR	SRR	SFR	PDR	CDR	PRR
Secure resolution (cont'd)			Are projected current and outyear DMSMS resolution budgets being developed on the basis of projected average resolution costs?	Have projected current and outyear DMSMS resolution budgets been established on the basis of projected average resolution costs?	Have projected current and outyear DMSMS resolution budgets been established on the basis of projected average resolution costs?	Have projected current and outyear DMSMS resolution budgets been established on the basis of projected average resolution costs?
			Have the projected resolution budgets been included in the program's Logistics Requirements and Funding Summary (LRFS)?	Have the projected resolution budgets been approved and included in the program's LRFS documentation?	Have the projected resolution budgets been approved and included in the program's LRFS documentation?	
			Is funding being sought on the basis of projected resolution budgets?	Have the resolution budgets been approved and funded?	Have the resolution budgets been approved and funded?	Have the resolution budgets been approved and funded?
Implement resolution				Are the DMSMS impacts on the notional BOM, identified during the parts availability analysis, resolved?	Are the DMSMS impacts on the build-baseline/final design BOM, identified during the parts availability analysis, resolved?	Are funded DMSMS resolutions being implemented on a timely basis?

Table 13. DMSMS Management Questions for Systems Engineering Technical Reviews: Other

Process	ASR	SRR	SFR	PDR	CDR	PRR
Not readily relatable to specific organizational principles, chapters, or processes			Is DMSMS management a consideration when the system design approach is being determined in order to minimize the impact on supportability and sustainability?	Is DMSMS management a consideration when the system design approach is being determined in order to minimize the impact on supportability and sustainability?	Is DMSMS a management consideration when the system design approach is being determined in order to minimize the impact on supportability and sustainability?	

Table 13. DMSMS Management Questions for Systems Engineering Technical Reviews: Other

Process	ASR	SRR	SFR	PDR	CDR	PRR
Not readily relatable to specific organizational principles, chapters, or processes (cont'd)			Are the following addressed: ◆ Open system architecture ◆ Order of precedence for parts selection (use of qualified manufacturers list parts, particularly for applications requiring extended temperature ranges) ◆ Selection of parts relatively new in their life cycle ◆ Minimized use of custom parts ◆ Requirement for a preferred parts list and parts control prior to detailed design to minimize obsolescence issues ◆ Identification of shelf and operating life requirements ◆ Identification of technology life expectancies.	Are the following addressed: ◆ Open system architecture ◆ Order of precedence for parts selection (use of qualified manufacturers list parts, particularly for applications requiring extended temperature ranges) ◆ Selection of parts relatively new in their life cycle ◆ Minimized use of custom parts ◆ Requirement for a preferred parts list and parts control prior to detailed design to minimize obsolescence issues ◆ Identification of shelf and operating life requirements ◆ Identification of technology life expectancies.	Are the following addressed: ◆ Open system architecture ◆ Order of precedence for parts selection (use of qualified manufacturers list parts, particularly for applications requiring extended temperature ranges) ◆ Selection of parts relatively new in their life cycle ◆ Minimized use of custom parts ◆ Requirement for a preferred parts list and parts control prior to detailed design to minimize obsolescence issues ◆ Identification of shelf and operating life requirements ◆ Identification of technology life expectancies.	
			Are DMSMS considerations incorporated into pertinent program documentation, e.g., LCSP, LRFS, TDS, Product Support Plan (PSP), and Acquisition Strategy (AS)?	Are DMSMS considerations incorporated into pertinent program documentation, e.g., LCSP, LRFS, TDS, PSP, and AS?	Are DMSMS considerations incorporated into pertinent program documentation, e.g., LCSP, LRFS, TDS, PSP, and AS?	Are DMSMS considerations incorporated into pertinent program documentation, e.g., LCSP, LRFS, TDS, PSP, and AS?

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Appendix D. DMSMS-Related Questions for Logistics Assessments

This appendix contains DMSMS-related questions intended for use by DMSMS practitioners to prepare for pre-IOC and post-IOC logistics assessments. The questions are presented in six tables. Tables 14–18, respectively, contain questions pertinent to the five DMSMS management steps: prepare, identify, assess, analyze, and implement. Table 19 contains questions that apply to logistics assessments but do not relate directly to a particular DMSMS step or process.

Table 14. DMSMS Management Questions for Logistics Assessments: Prepare (Chapter 3)

Process	Pre-IOC	Post-IOC
Develop DMP	Has the program established a robust DMSMS management strategy and program that identifies obsolescence due to DMSMS before parts are unavailable?	Is the DMSMS management program being executed per the formal approved DMP?
	Is this reflected in a formal DMP (DoD 4140.1-R, “DoD Supply Chain Materiel Management Regulation,” May 2003) that has been approved and signed by leadership?	Is the government DMP being updated, as necessary?
	Does the government DMP identify the roles and responsibilities of the prime/subcontractor and third-party vendors?	Has the government DMP been updated to identify the roles and responsibilities of the prime/subcontractors and third-party vendors as necessary?
	Have these roles and responsibilities for the prime/subcontractor and third-party vendors been established as contractual requirements where applicable?	Have these roles and responsibilities for the prime/subcontractor and third-party vendors been established as contractual requirements where applicable?
	Is a CDRL included for the delivery of the prime contractor’s DMP?	
	Where applicable, are there exit strategies in the contracts that require all sustainment providers to ensure no component end-of-life issues are unresolved at the completion of the period of performance?	Where applicable, are there exit strategies in the contracts that require all sustainment providers to ensure no component end-of-life issues are unresolved at the completion of the period of performance?
	Is the government conducting sufficient oversight when contractors are performing DMSMS operational processes?	Is the government conducting sufficient oversight when contractors are performing DMSMS operational processes?
Form DMT	Has the DMT been formed?	Has the DMT been formed?
	Do all identified DMT members understand their roles and responsibilities?	Do all identified DMT members understand their roles and responsibilities?
Secure operations funding	Are DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) being used to support funding requests?	Are DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) being used to support funding requests?
	Have current and outyear DMSMS operating budgets been established, approved, and funded?	Have current and outyear DMSMS operating budgets been established, approved, and funded?

Table 14. DMSMS Management Questions for Logistics Assessments: Prepare (Chapter 3)

Process	Pre-IOC	Post-IOC
Establish operational processes	Have all DMSMS operational processes been defined and documented in the government DMP?	Have all DMSMS operational processes been defined and documented in the government DMP?
Manage cases	Has the program defined DMSMS metrics that will be captured and tracked for DMSMS cases, trends, and associated resolutions and costs?	Has the program defined DMSMS metrics that will be captured and tracked for DMSMS cases, trends, and associated resolutions and costs?
	Has the program identified how it will capture and track DMSMS metrics?	Has the program identified how it will capture and track DMSMS metrics?
	Has the program developed or identified a DMSMS case tracking database?	Has the program developed or identified a DMSMS case tracking database?
	Is the program using DMSMS metrics to track DMSMS cases, trends, and associated resolutions and costs?	Is the program using DMSMS metrics to track DMSMS cases, trends, and associated resolutions and costs?
Evaluate program	Has a plan to report DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) been established?	Has a plan to report DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) been established?
	Are DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) being reported to program management?	Are DMSMS case management metrics (life-cycle costs and cost avoidance associated with DMSMS resolutions) being reported to program management?
Ensure quality	Have metrics been established to measure the efficiency of DMSMS operational processes and to drive continuous process improvement?	Are process efficiency metrics being used to drive continuous process improvement?

Table 15. DMSMS Management Questions for Logistics Assessments: Identify (Chapter 4)

Process	Pre-IOC	Post-IOC
Prioritize systems	Are mission criticality, operational safety, and DMSMS-related costs being used to identify and prioritize the systems and subsystems to be monitored?	Are mission criticality, operational safety, and DMSMS-related costs being used to identify and prioritize the systems and subsystems to be monitored?
Identify and procure monitoring and surveillance tools	Have DMSMS forecasting and associated data collection and management tools or service providers been researched and selected?	Have DMSMS forecasting and associated data collection and management tools been reviewed to determine their continued suitability for sustainment? Have tool selections been made to supplement, as necessary?
Collect and prepare parts data	Have the parts associated with critical functions been identified?	Have the parts associated with critical functions been updated?
	Is a CDRL included for the delivery of the system BOM?	
	Have indentured BOMs for the systems been acquired in accordance with DI-SESS-81656?	

Table 15. DMSMS Management Questions for Logistics Assessments: Identify (Chapter 4)

Process	Pre-IOC	Post-IOC
Collect and prepare parts data (cont'd)	Has the program obtained the following: ◆ Design disclosed items, including subtier hardware indenture levels ◆ F3/proprietary design items, including subtier hardware indenture levels ◆ Items that are single source and those for which the government cannot obtain data rights and the associated corrective action plans are identified?	
	Has each indentured BOM been loaded into the DMSMS forecasting/management tool?	Has the BOM been regularly updated and reloaded into a DMSMS forecasting/ management tool or service?
Analyze parts availability	Are the selected forecasting/management tool or the results of manual research being used to identify immediate and near-term obsolescence issues associated with the BOM?	Are the selected forecasting/management tool or the results of manual research being used to identify immediate and near-term obsolescence issues associated with the BOM?
	Is the program receiving obsolescence forecasts on a scheduled basis?	Is the program receiving obsolescence forecasts on a scheduled basis?
	Are product discontinuation notices being received regularly?	Are product discontinuation notices being received regularly?
Collect and update programmatic and logistics data	Have programmatic and predicted reliability data needs for impact assessment been identified or updated and collected?	Have programmatic and actual reliability and inventory data for impact assessment been updated and collected?

Table 16. DMSMS Management Questions for Logistics Assessments: Assess (Chapter 5)

Process	Pre-IOC	Post-IOC
Assess impact	Has a formal technology road map and approved insertion/refreshment plan been developed and funded?	Has a formal technology road map and approved insertion/refreshment strategy been reviewed for potential updates and adjustments?
	Does the technology road map and insertion/refreshment strategy focus on and address the identification of critical items and technologies, as well as emerging technologies?	Does the technology road map and insertion/refreshment strategy identify critical items and technologies, as well as emerging technologies?
	Is the technology insertion/refreshment plan being used to determine the time frame for potential DMSMS operational impacts?	Is the technology insertion/refreshment plan being used to determine the time frame for potential DMSMS operational impacts?
	Are DMSMS issues being considered as a basis for adjusting the scope or schedule of the technology refresh?	Are DMSMS issues being considered as a basis for adjusting the scope or schedule of the technology refresh?
	Are DMSMS operational risks being identified and prioritized?	Are DMSMS operational risks being identified and prioritized?

Table 17. DMSMS Management Questions for Logistics Assessments: Analyze (Chapter 6)

Process	Pre-IOC	Post-IOC
Determine resolution	Are resolutions to DMSMS impacts being identified for the BOM?	Are resolutions to DMSMS impacts being identified for the BOM?
	Is a BCA or AoA being performed (including ROI calculations) as part of the resolution determination?	Is a BCA or AoA being performed (including ROI calculations) as part of the resolution determination?
	Have all costs associated with a resolution been considered?	Have all costs associated with a resolution been considered?
	Do mitigation strategies clearly address the entire system life cycle (not just the contract period)?	Do mitigation strategies clearly address the entire system life cycle (not just the contract period)?
	Has resolution determination taken into account that the most cost-effective resolution may be found at a higher level of assembly?	Has resolution determination taken into account that the most cost-effective resolution may be found at a higher level of assembly?

Table 18. DMSMS Management Questions for Logistics Assessments: Implement (Chapter 7)

Process	Pre-IOC	Post-IOC
Secure resolution funding	Is funding to mitigate DMSMS risk being identified and obtained?	Is funding to mitigate DMSMS risk being identified and obtained?
	Have projected current and outyear DMSMS resolution budgets been established on the basis of projected average resolution costs?	Have projected current and outyear DMSMS resolution budgets been established on the basis of projected average resolution costs?
	Have these projected resolution budgets been approved and included in the program's LRFS documentation?	Have these projected resolution budgets been approved and included in the program's LRFS documentation?
	Have these resolution budgets been approved and funded?	Have these resolution budgets been approved and funded?
Implement resolution	Are funded DMSMS resolutions being implemented on a timely basis?	Are funded DMSMS resolutions being implemented on a timely basis?

Table 19. DMSMS Management Questions for Logistics Assessments: Other

Process	Pre-IOC	Post-IOC
Not readily relatable to specific organizational principles, chapters, or processes	Is DMSMS a consideration when the system design approach is being determined in order to minimize the impact on supportability and sustainability?	Is DMSMS a consideration when the system modification approach is being determined in order to minimize the impact on supportability and sustainability?
	Are the following addressed: ◆ Open system architecture ◆ Order of precedence for parts selection (use of qualified manufacturers list parts, particularly for applications requiring extended temperature ranges) ◆ Selection of parts relatively new in their life cycle ◆ Minimized use of custom parts ◆ Requirement for a preferred parts list and parts control prior to detailed design to minimize obsolescence issues ◆ Identification of shelf and operating life requirements ◆ Identification of technology life expectancies.	Are the following addressed: ◆ Open system architecture ◆ Order of precedence for parts selection (use of qualified manufacturers list parts, particularly for applications requiring extended temperature ranges) ◆ Selection of parts relatively new in their life cycle ◆ Minimized use of custom parts ◆ Requirement for a preferred parts list and parts control prior to detailed design to minimize obsolescence issues ◆ Identification of shelf and operating life requirements ◆ Identification of technology life expectancies.
	Are DMSMS considerations incorporated into pertinent program documentation, e.g., LCSP, LRFS, and PSP?	Are DMSMS considerations incorporated into updates of pertinent program documentation, e.g., LCSP, LRFS, and PSP?

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Appendix E. Counterfeit Parts and DMSMS

Counterfeit parts are a DMSMS management concern, because the parts purchased to mitigate a DMSMS issue may be counterfeit. This may happen with alternative or substitute parts, or even with the original parts, if they are purchased from an unauthorized supplier. Consequently, DMSMS resolution options using unauthorized sources have both additional technical risk and costs due to the extra screening and testing necessary to ensure that the parts are not counterfeit. This appendix begins with general background information on the proliferation of counterfeit parts, including how they are made and what risks are associated with them. It then expands on the impact of the counterfeit parts problem on DMSMS management.

E.1. Background

The number of counterfeit electronic components is proliferating in the open market, due to a number of factors. Below are the two primary factors:

- *Electronic scrap assemblies, also known as e-waste (electronic waste), are being shipped from all over the world to developing countries.* The United States alone produces an estimated 3 million tons of electronic waste yearly, and the annual world production of e-waste has been estimated to be as high as 50 million tons. The developing countries where the counterfeiting is most prevalent produce enough of their own e-waste to have an indefinite supply. Entities ranging from small business operators to organized crime syndicates have seized upon this material as an opportunity to remove and refurbish components, with the intent to resell them with the misrepresentation that the product is new. There is no threshold on the dollar value of the items being counterfeited, from half-penny capacitors to thousand dollar plus complex microprocessors. These components might also be falsely represented as higher grade product (higher speed, larger memory capacity, better operating temperature range, or subjected to military screening), which further increases the profit potential for the counterfeiter.
- *The growth of Internet sales has yielded unprecedented opportunities for profiteers to find a market for counterfeit products.* A buyer or business owner in the United States has the capability to use various Internet search engines to locate an enormous number of advertised components from all over the world. A recent Government Accountability Office (GAO) report highlighted concerns with these search engines, because an undercover team procured multiple suspect counterfeit parts and bogus parts.[79]

E.1.1. How Counterfeit Parts Are Made

Electronic parts can be counterfeited in several different ways, including the following:

- Cloning, that is, making a new product "from scratch" and misrepresenting it as the original brand
- Stealing authentic product (bare die or packaged parts) from the manufacturer's facility before completion of all processes, such as final test

[79] Government Accountability Office, *DoD Supply Chain: Suspect Counterfeit Electronic Parts Can Be Found on Internet Purchasing Platforms*, GAO-12-375, February 2012.

- Re-marking new product to misrepresent the part's function or pedigree (part number, date code or lot, country of origin, plating type, and so on)
- Re-marking used or scrap product to misrepresent the part's function or pedigree (part number, date code or lot, country of origin, plating type, and so on).

There is no accurate breakdown of the percentage of counterfeiting that can be attributed to each example above. However, it is generally accepted that the refurbishment of e-waste is a significant contributor to the counterfeit industry.

When electronic components are salvaged from electronic waste for resale, the processes for salvaging and refurbishing the parts occur most often in countries where manual labor is cheap and regulatory actions are limited or nonexistent. This allows the counterfeiter to maximize profit and evade criminal prosecution. Parts are removed from the scrap assemblies by melting the solder through uncontrolled heating processes. Parts are cleaned up. Leads are straightened and perhaps chemically treated and retinned to disguise signs of previous use. In some cases, cut leads are lengthened by attaching pieces of metal to the ends. If necessary, the actual part number and traceability information (lot code, date code, manufacturing facility, and country of origin) may be sanded off and a new coating applied to the part. For plastic or ceramic devices, this process is commonly referred to as "blacktopping." A new part number and traceability information are then applied to the blacktopping, either by ink or through laser etching. Counterfeiters are constantly improving their methods. They have been known to "flat lap" parts where the part markings are polished off of parts and to "microblast" parts, which involves sandblasting with various media (such as glass beads, walnut shells, or dry ice) to remove old markings and clean the devices. The newly marked part number may or may not match the actual part number. Below are the most common reasons for re-marking a salvaged component:

- Make the used part appear to be new.
- Make a group of parts from varied production lots appear to be from one homogeneous lot.
- Make a part appear to be a better, more expensive, or less available version of the actual part.
- Make a part appear to be a better, more expensive, or less available version of the same part type (not the same part).
- Make a part appear to be any type of "in demand" part (the part marking has nothing to do with the actual part).

Only the last example represents an instance in which a user might expect a failure during part or system-level testing. In all other cases, the counterfeit product might pass all initial testing, only to fail in the application environment much sooner than anticipated, perhaps catastrophically for the user.

E.1.2. Risks of Using Counterfeit Parts

Significant risks are associated with the use of counterfeit parts. The salvage or refurbishment process for used authentic parts, as described above, is usually accomplished with little regard for the part's internal integrity. Many plastic-encapsulated electronic parts absorb moisture over time. If excess heat is applied before the moisture can be baked out, the parts are easily damaged by the expanding gas as it exits the device. The damage takes the form of microcracks and inter-

nal voids that, if they do not cause immediate failure, can allow contaminants to seep in and dramatically reduce the part's life.

Of lesser risk, but still important, is the potential for component microcracks caused by mechanical flexure stress imparted onto the soldered parts when the populated printed circuit board is bent, twisted, or flexed during the salvage operation. As with thermally induced microcracks, the component's life may be reduced.

Handling of the parts in a non-electrostatic discharge (ESD) safe environment raises the distinct possibility of electrical damage to the part by applying static charges of thousands of volts to the component pins. Static-charge buildup is particularly possible during operations that generate repetitive friction, such as sanding a part number off. This type of damage is often latent, reducing the reliability of the device.

Even if new parts are simply being recoated, retinned, resold from process rejects, or made entirely from scratch, there are reliability risks beyond those associated with authentic parts. Testing may have been inadequate to eliminate break-in failures or to ensure operation to the specified environment. In addition, issues resulting from the handling and storage of the product by parties unacquainted with the moisture and ESD susceptibility of electronic parts, as discussed above, also apply to this product.

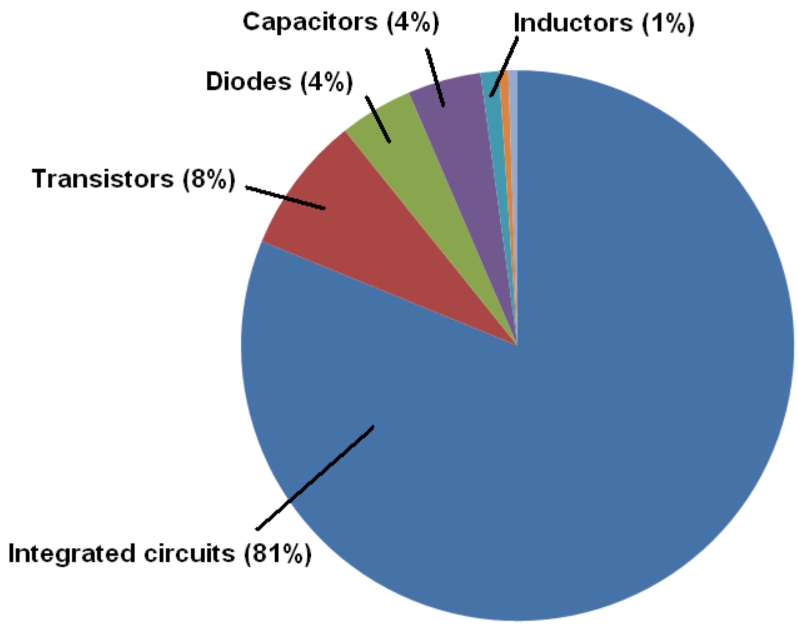
Finally, there is heightened concern for MilSpec components that have rigorous specifications and testing requirements from the OCM. MilSpec devices are not only opportunities for counterfeiters making a profit, but they introduce an opportunity for more nefarious "state-controlled" counterfeiters that may be interested in infiltrating or controlling a device or system.

E.1.3. Types of Parts Being Counterfeited

The most commonly counterfeited electronic parts are integrated circuits. However, there is still risk of obtaining counterfeit parts of other types. In fact, virtually every type of electronic part has been counterfeited. This includes electrical assemblies such as circuit breakers and entire COTS assemblies, such as Internet switches, down to small passive parts, such as ceramic capacitors. Figure 12 was gleaned from data supplied by ERAI in 2011.[80] The data indicate that over 80 percent of counterfeit parts are integrated circuits and that at least 93 percent of the counterfeits are integrated circuits or discrete semiconductors like transistors and diodes. However, that still leaves nearly 7 percent of the parts as non-semiconductor types, such as capacitors, inductors, connectors, and relays. Furthermore, it is suspected that many instances of counterfeiting are unreported; instead, failures are attributed simply to quality and reliability issues. Because few companies analyze failure mode effects when a system or assembly fails, it is unknown how large the problem truly is. When a profit is to be made, counterfeiters will make the attempt.

[80] ERAI is a privately held global information services organization that monitors, investigates, and reports issues affecting the global supply chain of electronics. Since 1995, ERAI has been the industry's primary reporting and investigation service, providing information and risk mitigation solutions to electronics professionals worldwide. See http://www.erai.com/Index.aspx.

Figure 12. Breakdown of Counterfeit Electronic Parts



E.2. The Impact of Counterfeit Parts on DMSMS Management

DMSMS issues directly impact the market price of counterfeit components, because obsolete parts are almost always more difficult to find than parts that are still in production. Approximately 50 percent of counterfeit electronic parts identified have been obsolete part numbers, indicating that the counterfeiter has made an obvious effort to tap the highly profitable DMSMS market. In addition to these parts being more likely to command a high price, obsolete parts are usually available only from the gray market where counterfeiters sell their product alongside legitimate unauthorized suppliers.[81]

Defense and aerospace products are particularly vulnerable to counterfeit parts due to parts obsolescence. Microelectronics, in particular, have life cycles far shorter than the defense and aerospace products that use them. Robust DMSMS management helps avoid the introduction of counterfeit parts, because the program will be more likely to deal with authorized suppliers.[82] Authorized suppliers include the OCM, OCM-authorized sales representative or distributors, or an aftermarket manufacturer that owns the intellectual property rights for the part. Whenever possible, DMSMS resolutions should use parts from authorized suppliers, rather than from unauthorized suppliers. The stigma of providing counterfeit parts to a valued customer can be sufficient to bankrupt a supplier and will inevitably damage the brand of the organization if the concern is enough to drive the customer base away. For that reason, the most reputable suppliers are extremely sensitive to the risk of counterfeit parts. Such companies seek to buy only authentic product and expend significant effort in identifying reputable sources. They accomplish this by aggressively monitoring part databases, industry blogs, internal purchasing quality history,

[81] A legitimate unauthorized supplier is a broker or independent distributor that does not knowingly sell counterfeit parts. Some independent distributors have robust processes and procedures in place to ensure quality, e.g., membership in the Independent Distributors of Electronics Association.

[82] See Under Secretary of Defense for Acquisition, Technology and Logistics, Memorandum, "Overarching DoD Counterfeit Prevention Guidance," March 2012.

and word of mouth. Likewise, those companies will maintain a list of sources that are not trusted, to ensure parts are not purchased from those companies.

The program may sometimes decide to purchase from unauthorized suppliers because of the expense or timeliness of other, less risky solutions. For example, it may not be possible to buy from any qualified source, and redesign may be too expensive. However, the risk of a part purchased in the gray market being counterfeit is high. For integrated circuits, the risk may be nearly 100 percent (the only remaining parts are refurbished product represented as new parts).

A check, in 2012, of a popular Internet parts search engine found a glut of counterfeits of an integrated circuit (randomly selected from an obsolete parts listing) that had been discontinued in 1998. In fact, more sources were listed on this site for parts date coded 2001 or later than during the part's production range of 1998 or earlier. Although certain military specifications (for example, MIL-PRF-38535 and MIL-PRF-19500) have clauses that require the identification of all known supply chain intermediaries back to the OCM, that requirement cannot often be met with material acquired from the open market. GAO also revealed that suspect counterfeit and bogus (the part numbers are not associated with any authentic parts) military-grade electronic parts can be found on Internet purchasing platforms.[83]

When the selected DMSMS resolution calls for parts to be purchased from an unauthorized supplier, programs must recognize that costs for minimum inspections and tests should be incurred to ensure that counterfeit parts do not enter the supply system. These costs should be factored into the determination of the most appropriate resolution option. No single test method can detect all the various methods of counterfeiting; counterfeiters keep improving the process to evade detection. Recommended inspections and tests are listed below:

- Visual inspection (IDEA-STD-1010), to look for signs of re-marking, refurbishment, repackaging, and so on.
- Testing of marking permanency (IDEA-STD-1010), to attempt to remove subpar ink markings or surface coatings.
- Testing of surface finish permanency (IDEA-STD-1010), to attempt to remove surface coatings. This should ideally include newer aggressive solvents proven to be more capable (than acetone) at removing newer, more robust coatings.
- X-ray fluorescence of component leads, to determine if the part has the correct plating composition.
- Radiological examination, to look for inconsistencies in the internal construction of the part.
- Scanning acoustic microscopy, to determine if there is internal delamination, which may indicate exposure to excess thermal stress associated with uncontrolled removal from an assembly.
- Decapsulation and die examination, to determine whether the die markings are consistent and as expected for the purchased part.
- Curve trace or DC electrical test of the device (for microcircuits) or a value measurement (for passive devices).

[83] Government Accountability Office, *DoD Supply Chain: Suspect Counterfeit Electronic Parts Can Be Found on Internet Purchasing Platforms*, GAO-12-375, February 2012.

The inspections and tests above can provide a degree of confidence as to whether a high-risk purchase contains authentic or counterfeit parts. However, parts may pass some or all of the tests and still be counterfeit. Additional testing may be required based on the application risk, risk of the component in the application, and risk of the supplier. The cognizant engineer should provide input on the appropriate level of testing, considering the total risk associated with the situation. All testing should be performed by a test laboratory that is qualified to perform the work. Conversely, parts may fail some of the tests and still be authentic. The only way to truly maximize the confidence in parts bought from unauthorized suppliers is to contact the OCM for the parts and to have that organization review the analysis and weigh in on the authenticity of the product. Unfortunately, OCMs are under no contractual obligation to assist with these analyses if the parts have been purchased from the gray market. In addition, the OCM may not be able to determine, from the test paperwork alone, if the parts are authentic.

If the OCM agrees to review the analysis, then the requestor should provide as much detail as possible about the product, such as the following:

- A 10X photograph of all external part markings, including bottom-side markings
- Photos of packaging and documentation for the parts
- Description of which inspections and tests the parts failed and how they failed
- High-magnification photos of the die markings.

OCMs state that a part can often be identified as counterfeit strictly by comparing the manufacturing logo, fonts, or lot and date code information against their internal data. However, counterfeiters often are expert at copying legitimate manufacturer markings and have access to legitimate die due to the e-waste issue.

If analysis confirms that the parts are likely counterfeit or fraudulent, the parts must be contained. Return of the parts for refund or for any other reason is not acceptable, because those parts may simply be reinserted into the gray market for future resale.

Counterfeit and fraudulent parts must be reported to the appropriate authorities and organizations. The Government-Industry Data Exchange Program (www.gidep.org) is the preferred location for reporting counterfeit parts. In addition, all government and contractor organizations are required—by the 2012 National Defense Authorization Act, Section 818, and in DoD guidance—to report suspect or confirmed counterfeit electronic parts intended for DoD systems. They also should alert investigative authorities as appropriate, because this may lead to prosecution of the offending parties.

Appendix F. Accessing Organic Services and Capabilities to Mitigate DMSMS Issues

Today's PMs, PSMs, and technical personnel are finding increasingly significant challenges in locating and securing supply solutions for legacy DoD systems. These challenges can only increase as the service life of DoD systems is extended. A number of unique engineering, manufacturing, and sustainment capabilities exist within the government's industrial base and can be leveraged to help meet DMSMS challenges.

The government's industrial base encompasses all of the manufacturing and sustainment providers that are owned and operated by the government. This includes the DoD locations termed arsenals and depots, as well as a portion of the National Laboratory system within the Department of Energy.

A list of all government industrial base locations is maintained to foster DMSMS community awareness of their capabilities and to expedite communications. Locations on this list have some manufacturing capabilities on-site and can support DoD organizations. The location list is periodically updated with information such as key contacts and addresses. Each key contact has agreed to be an initial point of contact for DoD personnel who are soliciting help on DMSMS issues. In addition, a more specific capabilities matrix has been created for participating government industrial base locations to specify their areas of manufacturing expertise, as well as to describe their mechanical, electronic, materials, and test and evaluation capabilities.

The location list and capabilities matrix are designed to be complementary when used in tandem. For example, a DMSMS practitioner, who has unfulfilled requirements for integrated circuit manufacturing, can review the capabilities matrix to identify which government locations have those capabilities. Then the location list can be used to contact the respective locations to pursue particular DMSMS resolutions for that issue.

The most recent update of the government industrial base location list and capabilities matrix can be accessed within the DKSP.

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Appendix G. DMSMS Knowledge Sharing Portal

The DKSP contains DMSMS-related information, resources, and material. Use of the DKSP will enable the DMSMS community, both organic and contractor, to implement best practices for robust DMSMS management. The DKSP is supported by the Defense Standardization Program Office (http://www.dsp.dla.mil) and is currently located within the DAU Acquisition Community Connection (ACC) website (https://acc.dau.mil). The DKSP is just one of a number of communities of practice (CoPs) hosted by the ACC, whose purpose is to connect people and acquisition know-how across DoD and industry. CoPs enable interaction and sharing of resources and experiences to support job performance, avoid duplication of effort, and advance the connection of people and ideas.

Participation in the ACC is free and completely voluntary, and much of its content is open to the public, requiring no login to access the extensive knowledge base. Although much of the information is publicly available, individuals, who qualify, can request ACC membership access. Becoming an ACC member provides additional capabilities that guests do not have. Those capabilities include accessing other members' contact information, initiating and participating in discussions, contributing and sharing knowledge, creating bookmarks, subscribing to updates, and accessing restricted community knowledge. The DKSP can be accessed utilizing one of two links: https://acc.dau.mil/dmsms or http://www.dmsms.org.

The DKSP content is organized by topic, shown on the left of the page, in a user-friendly format for easy navigation. The topics are as follows:

- *Conferences and Events.* The content is broken down into (1) DMSMS conferences and (2) other DMSMS-related events (workshops, clinics, forums, symposiums, and so on).
- *DMSMS Training Courses.* The content lists available DMSMS and other related training.
- *Organizations and Groups.* The content is broken down by organization: DoD, DLA, Other Government, Army, Navy, Air Force, Marine Corps, and Industry.
- *Tools and Management Aids.* The content is broken down by organization: DoD, DLA, Other Government, Army, Navy, Air Force, Marine Corps, and Industry.
- *Policy and Guidance.* The content is organized by policy, guidance, and manuals/handbooks for DoD, DLA, Other Government, Army, Navy, Air Force, and Marine Corps and by standards for Industry.
- *DMSMS Library.* The content is broken down by organization: DoD, DLA, Other Government, Army, Navy, Air Force, Marine Corps, and Industry.

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Appendix H. DMSMS Quality Assurance Process

A quality management system (QMS) is the basis for quality assurance. A QMS is an overarching framework that defines the organizational structure, responsibilities, methods, data management, processes, resources, customer satisfaction, and continuous improvement. The mitigation of DMSMS issues must be controlled in a QMS to receive optimal benefit and ensure consistency over time. A well-defined QMS can also ensure that the same high level of quality service and products can be produced regardless of personnel changes. This appendix focuses on control of DMSMS management processes.

H.1. Quality Plan

The QMS should call for a quality plan (as part of the DMP) that defines the checks of the system or product necessary to ensure quality; that is, to ensure processes and product are in control and meet defined requirements. An excellent means of controlling processes is to document the responsibilities and methods associated with the processes in a series of procedures or work instructions and to establish quality checks at optimal points within the process to ensure that the work product meets defined quality standards. Quality checks are verifications to demonstrate whether the process is operating as defined. The quality plan should include the identification, collection, and monitoring of meaningful metrics to ensure that the process is successful. Metrics provide information as to whether the process must be adjusted to meet the intended outcome.

Different entities may use specific nomenclature to name the written process definitions, such as standard operating procedures, standing operating procedures, or work instructions. The nomenclature chosen for this documentation does not matter. This appendix suggests a naming scheme to provide clarity to the concept being presented.

A written procedure outlines how to perform a process. This level of documentation typically applies to the processes common across a function, such as DMSMS support. Because DMSMS support can vary significantly from one platform to the next, a second tier of process definition should be developed. This second level, often known as work instructions, is used at a workgroup level to define how to perform a task. Each platform support team should develop its unique DMSMS support work instruction tailored to the support of its specific platform.

As an example of how this system may function, consider the processes to collect and disseminate PDNs and obsolescence event data, often referred to as “Alerts.” PDNs are published by part manufacturers to inform the industry that a part is targeted for discontinuance. A procedure could be written for how to find, confirm, and document this obsolescence event data. The platform support teams may take different actions in response to an alert; each team could write work instructions to describe its own specific process.

The general workflow in support of DMSMS management consists of data collection from many diverse sources, data compilation and analysis, risk assessment, and report/briefing development. Because data collection, manipulation, and analysis are at the heart of DMSMS team activities, data standards should be clearly defined. Data standards define such aspects of data management as content accuracy, data content, and data entry standards.

To establish quality checks, the DMT should review all of the process inputs and outputs. For each data stream, whether input or output, the DMT must decide the characteristics of a good

record. The DMT should document these characteristics and make them available to the DMT members who may create or process that type of record.

The DMT determines the method to identify records that do not meet the defined standards. Quality checks can range from automated comparison of records to defined standards to simply having an experienced team member review the work of a less-experienced DMT member.

The DMT should review the process flow and determine where to insert quality checks. These locations are the points at which errors can be identified and corrected before additional work is applied and before the customer is affected. The quality plan should include the inspection points, the inspection method, and the error correction mechanism.

To demonstrate a quality check of data content accuracy, consider the record of availability status of a highly complex electronic part. In general, the obsolescence of such a part, in contrast to a part that is of low complexity, has a greater impact on the mission of the platform, and the mitigation of such a part can be much more difficult. Therefore, the accuracy of the data concerning this type of part is critical. In such a situation, the DMT may decide that the verification of the content accuracy of the availability status of this type of part may require manufacturer contact or no less than two predictive tool providers to report the availability status for the part. The quality check to ensure content accuracy for this type of record could be to check that the availability record was verified by contact with the manufacturer or by the use of more than one predictive tool. For example, the DMT may decide that the part description in a part availability record must exactly match the approved list of part descriptions. The quality check would then determine whether, in fact, the entry for a part description matches the entry on the table of approved parts.

This same principle can be applied in other data streams, such as the recording of mitigation efforts, often called case data. The DMT may decide that the implementation date for the mitigation of an obsolete part should be recorded. In this situation, a quality check would verify the presence of an implementation date associated with all records tagged as “implemented.”

H.2. Metrics

Metrics measure the status of processes and activities within a quality plan. Keep in mind that metrics discussed in this appendix are measuring the DMSMS management processes operated by the DMT. This discussion does not include metrics focused on mission impact, such as cost avoidance. Among the reasons that a process fails are budgeting of too little time or too little money, inadequate planning, constantly changing goals, lack of process knowledge, and ineffective communication. Often when a process is in danger of failing, management is unaware of the problems.

One of the best tools for avoiding process failures is to track key indicators of process health. The data should be presented in a meaningful way to help process managers make the proper decisions, take corrective steps on processes, or both. It is also important to define the right measurable periods that can cover possible gaps in the control of the measuring indicators, as well as allow control of the situation upfront if a failure occurs within the measurable intervals.

Process-specific metrics generally must have another figure—such as an industry benchmark or regulatory guidelines—against which they can be compared. However, sometimes metrics apply only to a particular organization, so no industry benchmarks would be available.

Five general criteria are typically used when defining metrics for a process:

- Time
- Cost
- Resources (e.g., person-hours)
- Quality
- Actions.

When metrics are first applied to a process, it is often difficult to separate the categories of time, cost, and resources. Tracking metrics that provide information on combinations of two or more of these concepts is a viable approach. As the QMS matures and the situation necessitates, metrics can be redefined to provide more focused data. Below are two examples:

- Electronic part availability research is necessary for programs that have parts lists or BOMs. This research can be time consuming. Establishing the availability of these parts is also a product supplied by the predictive tool suppliers. In general, it could be more cost-effective and timely to the DMSMS professional to obtain part status data from at least one predictive tool supplier. One measure of resource usage would be to track the percentage of parts that the predictive tool companies recognize. By working with the predictive tool suppliers to increase the recognition rate of parts, the team is effectively moving part research from an internal process to a subscription deliverable and, thus, is using resources more effectively.
- The data management in support of DMSMS management contains several distinct processes. A metric to provide feedback on adherence to schedule could be obtained by tracking the time to perform these intermediary processes, such as the time from receipt of a parts list or BOM to identification of the components to be monitored for availability. The time to perform the intermediary processes is then compared to a standard time established for this process. Metrics values consistently over the standard indicate that a problem exists in the process. Metrics consistently under the standard indicate a need to adjust the standard because the process has been improved.

The quality metric focuses on whether appropriate actions are taken in response to finding a process defect, not the existence of defects. The metric chosen should provide insight as to whether defects are tolerated or, even worse, ignored. In data management, a defect is a situation in which a defined standard is not met. Below are some examples:

- The DMT may require, in the quality plan, measurement of the conformance of configuration records to defined standards. The associated metric would be to track the number of defective configuration records periodically and then to show the trend for this value. If the number of errors is higher than the acceptable quality level or increases over time, a problem exists with the quality of the configuration management process.
- The DMT may choose to open a mitigation record for each monitored part that has an obsolescence issue. The DMT could then track the number of parts with obsolescence issues that do not have an associated mitigation record. In this situation, the quality of the program support process is being measured.

The actions metric focuses attention on identifying outstanding action items as a means of determining possible barriers to the process success. To use this type of metric, the DMT should

maintain an action item summary in support of the process steps. This action item summary should then be reviewed to develop metrics:

- Any differences between the action completion date and the projected completion date may indicate that a problem existed for that task. The difference between the action completion date and the projected completion date should be compared to a calculated standard established for support of that platform. This metric is most meaningful for DMT members accustomed to setting reasonable projected completion dates.
- A quick metric to calculate is the number of open items. This metric measures multiple program aspects. This metric may measure the skill of the program manager in capturing the steps necessary to support the program. This metric also may indicate that a project is experiencing difficulties in completing tasks.

Beyond these general metric categories, there are also some more intangible signs that a project may be in trouble. These signs include a general lack of interest in the project, poor communication among team members, a fear of talking about project problems, and a generalized lack of project advancement.

To be successful, metrics must be well thought out and consistently applied. The DMT must be very clear as to the meaning of the metric values. Finally, the DMT must act upon the process health conclusions provided by the metrics in a timely manner to correct or improve the process, metric, or both.

Appendix I. DMSMS Program Capability Levels

The DMP should include plans for achieving the target DMSMS capability level. This appendix contains information to help guide a decision on the appropriate level for a program.

Table 20 identifies the program capability levels for each DMSMS management step and process. The levels are defined as follows:

- Level 1 represents minimal DMSMS management capability. Practices are largely reactive.
- Level 2 represents a DMSMS management capability greater than Level 1. Practices are somewhat proactive in situations where proactive practices are needed.
- Level 3 represents a DMSMS management capability greater than Level 2. Proactive practices are used when needed.
- Level 4 represents robust DMSMS management capability. Comprehensive efforts are being applied whenever required.

A program should use the table as the basis for determining the current state of its DMSMS management practices. This is done by examining each row of the table and identifying what is being done. If the program does not have a DMP, then it is effectively below capability Level 1. The DMP should provide a basis for systematically progressing through the capability levels to achieve its target. Several factors should be considered when determining the appropriate target capability level for a program:

- A lower capability level could be sufficient near the end of a system's life cycle.
- A higher capability level might be needed for more complex systems, because such programs are more likely to encounter DMSMS issues. However, smaller programs may be seriously affected, depending on the technologies used.
- A higher capability level cannot be achieved without significant DMSMS subject matter expertise and DMSMS training for the entire DMT.
- Not every DMSMS management process must be at the same capability level.
- A program cannot immediately move from a low capability level to a high capability level; the transition should be gradual.
- Resource constraints may exist, either for a single program or for a group of programs.

Table 20. DMSMS Program Capability Levels

Step	Process	Level 1	Level 2	Level 3	Level 4
Prepare	Develop DMP	DMP developed	DMP developed, approved, and signed by program leadership	DMP developed, approved, and signed by program leadership	DMP developed, approved, and signed by program leadership
		DMP calls for no or minimal government oversight of contractor activities	DMP calls for some government oversight of contractor activities	DMP calls for extensive government oversight of contractor activities	DMP calls for extensive government oversight of contractor activities

Table 20. DMSMS Program Capability Levels

Step	Process	Level 1	Level 2	Level 3	Level 4
Prepare (cont'd)	Form DMT		DMSMS point of contact established (but retains other duties)	Full DMT formed to include all stakeholders with an understanding of their roles and responsibilities	Full DMT formed to include all stakeholders with an understanding of their roles and responsibilities
			DMSMS point of contact trained	DMT trained	DMT members have advanced DMSMS training
	Secure operations funding	No DMSMS-earmarked funding	Funded to operate at Level 2	Funded to operate at Level 3 Funding shortfall and impact identified and reported to decision makers	Funded to operate at Level 4
	Establish operational processes	DMSMS operational processes entirely ad hoc and reactive	DMSMS operational processes defined, but not documented	DMSMS operational processes defined and documented, and processes are proactive when needed	DMSMS operational processes defined and documented, and processes are proactive when needed
	Manage case	No record keeping or metrics	Ad hoc record keeping and some metrics	Record keeping formalized and metrics collected	Record keeping formalized and metrics collected
	Evaluate program			Metrics aggregated and analyzed to improve program performance; metrics used to justify operational budgets	Metrics widely accepted and used by program management
	Ensure quality			Quality assurance (QA) metrics established and used for corrective action and continuous process improvement	QA metrics established and used for corrective action and continuous process improvement
Identify	Prioritize systems		Subsystems prioritized for DMSMS management efforts	Subsystems prioritized for DMSMS management efforts	Subsystems prioritized for DMSMS management efforts
	Identify and procure tools		Predictive tools and data management tools in place	Comprehensive DMSMS management systems in place	Comprehensive DMSMS management systems in place
	Collect and prepare parts data	Only miscellaneous parts data collected; everything driven by PDNs	BOM data collected, but may not be indentured	Indentured BOM data collected; vendors surveyed for COTS assemblies and mechanical parts	Indentured BOM data collected; vendors surveyed for COTS assemblies and mechanical parts

Table 20. DMSMS Program Capability Levels

Step	Process	Level 1	Level 2	Level 3	Level 4
Identify (cont'd)			BOM data errors corrected	Parts prioritized and determination made regarding which parts to exclude from proactive monitoring	Parts prioritized and determination made regarding which parts to exclude from proactive monitoring
	Analyze parts availability		Results of predictive analyses examined continually	Results of at least two predictive tools examined continually Vendors surveyed periodically for COTS assemblies and mechanical parts	Results of at least two predictive tools examined continually Vendors surveyed periodically for COTS assemblies and mechanical parts
	Collect and update programmatic and logistics data			Some logistics and programmatic data collected for impact assessment	Comprehensive logistics and programmatic data collected for impact assessment
Assess	Assess impact	Ad hoc; only when PDN received	Only parts availability considered	Some logistics and programmatic data and vendor surveys being used to determine when an operational impact will occur	Extensive logistics and programmatic data and vendor surveys being used to determine when an operational impact will occur
				Rough priorities being assigned	Specific priorities being assigned; next higher levels of assembly being examined for operational impact
				Technology road maps being used to determine impact	Technology road maps being used to determine impact
Analyze	Determine resolution	Ad hoc; limited cost data used	AoA conducted using unrefined cost factors	AoA and BCA conducted using refined cost factors, tailored to the specific problem	Resolution options determined at item level and for higher levels of assembly
Implement	Secure resolution funding	No resolution budgets; funding sought on case-by-case basis	No resolution budgets; funding sought on case-by-case basis	Resolution budgets funded based on projections of issues; outyear budgets unfunded	Active engagement in obtaining other sources of funding; outyear budgets programmed
	Implement resolution	No follow-up	Minimal oversight of execution	Comprehensive oversight of execution	Comprehensive oversight of execution

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Appendix J. Lead-Free Electronics and DMSMS Resolutions

For over 50 years, the electronics industry has relied on tin-lead (SnPb) solder as the primary means of interconnection between electronic devices.[84] The European Union's Restriction of Hazardous Substance (RoHS) directive, issued in January 2003, and other international and domestic mandates to eliminate materials deemed hazardous to health have forced the electronics industry to adopt solders and termination finishes free of lead (Pb). Although aerospace and defense electronics are excluded from these Pb-free mandates, many of their component suppliers are consumer electronics companies, driven by the needs of high-volume customers that demand RoHS compliance to enter or preserve European markets. Suppliers sometimes provide products in two forms, but usually only temporarily, before converting to a single Pb-free (RoHS compliant) version. New products are being introduced almost exclusively in Pb-free form.

Nearly all parts and material suppliers and most board assemblers represent the lowest tiers of the global electronics supply chain. Avionics OEMs and logistics, maintenance, and repair providers draw upon this global supply chain, along with a few captive aerospace suppliers, to provide electronics subsystems to platform integrators and operators. As a result, highly demanding aerospace and defense applications are being forced to use components targeted for high-volume commercial markets with far less demanding requirements. Manufacturing in the global electronics supply chain cannot be controlled by the low-volume aerospace and military electronics customers.

Avionics, defense electronics, and other high-reliability electronic applications differ in significant ways from the vast majority of commercial and consumer electronic applications. Field environments often include extreme temperature and humidity, high altitude, high levels of shock and vibration, underwater exposure, or the extremes of space. Product lifetimes are often measured in decades, rather than in years. Contrary to most commercial practices, maintenance and repair activities are routinely performed down to the replacement of individual components on circuit cards. These maintenance and repair activities often occur many years after initial manufacture, at varied and distant locations, and under the control of agencies not always under the direction of the OEM. Finally, failure of the equipment to perform may have dire consequences.

The reliability of SnPb interconnections is well known and meets the requirements of these more demanding applications. In contrast, the scientific information indicates increased reliability risks in using Pb-free in high-performance electronics. These risks include the spontaneous formation of tin whiskers from Pb-free tin-based finishes, reduced Pb-free solder joint integrity, reduced reliability by cross-contamination between the different alloys, and the potential component and board damage from the higher Pb-free processing temperatures.

The first consideration in DMSMS management of Pb-free electronics is the risks of using them in the program. The program must therefore determine where Pb-free solder is acceptable and where it must not be used. For example, a program may determine that Pb-free components are viable options, but that the leads need to be applied with a SnPb finish prior to installation. Or, as another example, a program may determine that Pb-free components can be used for all non-mission-critical systems, but not for any mission-critical components, which should continue to use only leaded parts.

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[84] The material in this appendix was taken from *Pb-Free Electronics Risk Management (PERM) Consortium White Paper*, December 2009 (http://www.aia-aerospace.org/assets/2009-12-22_PERM_White_Paper_FINAL.PDF).

Pb-free components affect DMSMS risk management in two ways. First, they affect the technical viability of certain resolution options. Alternative parts that do not use SnPb solder cannot be considered. Second, it may be necessary to take mitigation steps when buying parts. For example, x-ray crystallography may be needed to determine whether or not SnPb solder was used and to prevent Pb-free components from entering the supply system. Another option could be the use of conformal coatings to discourage the growth of tin whiskers.

Standards have been developed to help manage the effects of Pb-free electronics, as follows:

- GEIA-STD-0005-1, "Performance Standard for Aerospace and High Performance Electronic Systems Containing Lead-free Solder"
- GEIA-STD-0005-2, "Standard for Mitigating the Effects of Tin in Aerospace and High Performance Electronic Systems"
- GEIA-STD-0005-3, "Performance Testing for Aerospace and High Performance Electronics Containing Lead-free Solder and Finishes"
- GEIA-HB-0005-1, "Program Management/Systems Engineering Guidelines for Managing the Transition to Lead-free Electronics"
- GEIA-HB-0005-2, "Technical Guidelines for Aerospace and High Performance Electronic Systems Containing Lead-free Solder"
- GEIA-HB-0005-3, "Rework and Repair Handbook To Address the Implications of Lead-Free Electronics and Mixed Assemblies in Aerospace and High Performance Electronic Systems"
- GEIA-HB-0005-4, "Guidelines for Performing Reliability Predictions for Lead-Free Assemblies used in Aerospace and High-Performance Electronic Applications" (in review).

Appendix K. Abbreviations

ACAT	Acquisition Category
ACC	Acquisition Community Connection
AME	Advanced Microcircuit Emulation (program)
AoA	analysis of alternatives
ARCI	Accountable/Responsible/Consulted/Informed
AS	Acquisition Strategy
ASIC	application-specific integrated circuit
ASR	Alternative Systems Review
AvCIP	Aviation Component Improvement Program
BCA	business case analysis
BOM	bill of materials
CCB	configuration control board
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CM	configuration management
CoP	community of practice
COTS	commercial off-the-shelf
DAC	Defense Acquisition Challenge
DAG	Defense Acquisition Guidebook
DAU	Defense Acquisition University
DAWIA	Defense Acquisition Workforce Improvement Act
DKSP	DMSMS Knowledge Sharing Portal
DLA	Defense Logistics Agency
DMP	DMSMS management plan
DMSMS	Diminishing Manufacturing Sources and Material Shortages
DMT	DMSMS management team
DoD	Department of Defense
DoDD	DoD Directive
DTM	Directive Type Memorandum
ECP	engineering change proposal

EOL	end of life
ESD	electrostatic discharge
F3	form/fit/function
FCT	Foreign Comparative Testing (program)
FMS	foreign military sales
FOC	Full Operational Capability
FRP	full rate production
GAO	Government Accountability Office
GEIA	Government Electronics and Information Technology Association
GEM	Generalized Emulation of Microcircuits (program)
GFE	government-furnished equipment
GIDEP	Government-Industry Data Exchange Program
ICA	Industrial Capability Assessment
IDEA	Independent Distributors of Electronics Association
IMM	integrated materiel manager
IOC	Initial Operational Capability
IPT	Integrated Product Team
LA	logistics assessment
LCL	life-cycle logistics
LCSP	Life-Cycle Sustainment Plan
LECP	logistics engineering change proposal
LRFS	Logistics Requirements and Funding Summary
LRU	line replaceable unit
ManTech	Manufacturing Technology (program)
MilSpec	Military Specification
MS	milestone
NAVAIR	Naval Air Systems Command
NHA	next higher assembly
NPV	net present value
NTE	not to exceed
O&S	operating and support
OCM	original component manufacturer

OEM	original equipment manufacturer
OSCR	Operating and Support Cost Reduction (program)
OSD	Office of the Secretary of Defense
Pb	lead
PBL	performance-based logistics
PDN	product discontinuance notice
PDR	Preliminary Design Review
PERM	Pb-Free Electronics Risk Management
PM	program manager or program management
PO	project officer
PQM	production, quality, and manufacturing
PRR	Production Readiness Review
PSE	program systems engineering
PSM	product support manager
PSP	Product Support Plan
QA	quality assurance
QML	Qualified Manufacturers List
QMS	quality management system
QPL	Qualified Products List
R&D	research and development
RDT&E	research, development, test and evaluation
RoHS	Reduction of Hazardous Substances
ROI	return on investment
ROM	rough order of magnitude
SCD	Source Control Document
SE	systems engineering
SFR	System Functional Review
SME	subject matter expert
Sn	tin
SOO	statement of objectives
SOW	statement of work
SPRDE	systems planning, research, development, and engineering

SRA	shop replaceable assembly
SRR	Systems Requirements Review
SRU	shop replaceable unit
STM	science and technology management
T&E	test and evaluation.
TDP	technical data package
TDS	Technology Development Strategy
U.S.C.	United States Code
VE	value engineering
VECP	value engineering change proposal
VEI	value engineering incentive
WCF	working capital fund
WRA	weapon replaceable assembly

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